Section V. HAZARD IDENTIFICATION & RISK ASSESSMENT

The Hazard Identification and Risk Assessment (HIRA) serves as a guide to communities in the Richmond Regional planning area when assessing potential vulnerabilities to natural hazards. When developing this plan, every effort was made to gather input from all stakeholders within the participating communities to assure that the results of this analysis will be as accurate as possible. The planning area for this study includes the City of Richmond, and Charles City, Goochland, Hanover, Henrico, New Kent, and Powhatan counties, and the Town of Ashland.

The purpose of this HIRA is to:

1) Identify all the natural hazards that could affect the Richmond Regional planning area;
2) Assess the extent to which the area is vulnerable to the effects of these hazards; and
3) Serve as a basis for the prioritization of potential mitigation measures.

The first step, identifying hazards, will assess and rank all the potential natural hazards, in terms of probability of occurrence and potential impacts. It will also identify those hazards with the highest likelihood of significantly impacting the community. This section will be completed based on a detailed review of the Richmond Regional planning area's hazard history, along with national and regional hazard related data. The hazards determined to be of the highest risk will be analyzed further to determine the magnitude of potential events, and to characterize the location, type, and extent of potential impacts. This will include an assessment of what types of development are at risk, including critical facilities and community infrastructure.

Data Limitations

In order to gain a full understanding of the hazards, an extensive search of historic hazard data was completed. This data collection effort utilized meetings with local community officials, existing reports and studies, state and national data sets, and other sources. A comprehensive list of sources utilized for this plan can be found in Section IX of this document.

Whenever possible, data has been incorporated into a Geographic Information System (GIS) to aid in analysis and to develop area-wide maps for depicting historical hazard events, hazard areas, and vulnerable infrastructure. Critical facility data has been collected from the Federal Emergency Management Agency's (FEMA) loss estimating module, Hazards U.S. – Multi-Hazards (HAZUS-MH), and has been supplemented, to the extent possible, by local data.

In accordance with FEMA mitigation planning guidance, the results of this study are based on the best available data. The amount of detailed data regarding the location of structures, characteristics of facilities, and other community related data varies from jurisdiction to jurisdiction. For instance, Charles City County had structure point information that provides an approximate location of the structure while other jurisdictions had parcel data but no information on the location of structures on the parcel.

Recognizing this deficiency in detailed local data, one strategy included as part of this mitigation plan is to increase the quality and detail of data to prepare usable and effective hazard assessments.

In addition, information from the National Climatic Data Center's (NCDC) Storm Event Database was used in the flood, severe wind, and severe winter storm analysis. The NCDC receives storm data from the National Weather Service, which in turn receives it from a variety of sources, which include but are not limited to: county, state and federal emergency management officials, local law enforcement officials, skywarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry and the general public. An effort is made to use the best available information but because of time and resource constraints, information from these sources may be unverified by the NWS. Therefore, the recurrence intervals and other historical analysis presented may not be one hundred percent accurate but instead are based on best available data. In addition, there may be discrepancies in data reporting between jurisdictions that have similar experience or exposure to hazards (i.e., neighboring Charles City and New Kent counties).

Hazard Identification

While there are many different natural hazards that could potentially affect the communities within the Richmond Regional Planning District, some hazards are more likely to cause significant impacts and damages than others. Although reducing the community's vulnerabilities to all hazards is ideal, the highest level of consideration must be given to those hazards which pose the greatest possible risk. This analysis will attempt to quantify these potential impacts for all possible hazard events, and identify those that could most significantly impact the communities included in this study. Once these hazards have been identified, further analysis will be conducted to profile potential hazard events and to assess the communities' vulnerability to such events.

Types of Hazards

While nearly all disasters theoretically are possible for any given area in the United States, the likely hazards that are most probable to affect the communities in the Richmond Regional Planning District include:

- Drought
- Earthquake
- Extreme heat
- Flooding
- Hail storm
- Landslides, land subsidence, soil erosion
- Severe wind
- Severe winter storm
- Tornado
- Wildfire

Depending on the severity, location, and timing of the specific events, each of these hazards could have devastating effects on the region's citizens and their homes, businesses, farms, and supporting infrastructure.

Probability of Hazards

The historical data collected includes accounts of all the hazard types listed above. However, some hazards have occurred much more frequently than others with a wide range of impacts. By analyzing the historical frequency of each hazard, along with the associated impacts, the hazards that pose the most significant risks to the Richmond Regional Planning District can be identified. This analysis will allow the local communities to focus the Mitigation Strategy of those hazards that are most likely to cause significant impacts.

Prioritizing the potential hazards that can threaten the Planning District will be based on two separate factors:

- the probability that a potential hazard will affect the community, and
- the potential impacts on the community in the event such a hazard occurs.

The probability of a hazard event occurring is largely based on the historical recurrence interval of the hazard. For instance, if flood damage occurs every 5 years versus an earthquake event causing damage every 50 years, the flood probability would score higher than the earthquake.

The hazard's impact on the community is made up of three separate factors: the extent of the potentially affected geographic area, the primary impacts of the hazard event, and any related secondary impacts. While primary impacts are a direct result of the hazard, secondary impacts can only arise subsequent to a primary impact. For example, a primary impact of a flood event may be road closures due to submerged pavement. A possible secondary impact in these circumstances would be restricted access and slower response times of emergency vehicles to citizens in a portion of the community due to the road closure.

Level of Hazard

A formula has been developed to assign a value for probability and impact for each of the hazards considered. A *Hazard Analysis Worksheet*, as well as a detailed description of all the calculations and formulas utilized, is included as Appendix C of this document. Early in the planning process, a *Hazard Analysis Worksheet* was made available to stakeholders from each jurisdiction for use in this analysis. The input from stakeholders, along with regional and national hazard data, formed the bases of the hazard identification results. As a result of this analysis, the hazards were broken down into four distinct categories which represent the level of consideration they will receive throughout the planning process. These categories are *Significant, Moderate, Limited,* and *None*. Table V-1 summarizes the results of the hazard identification and prioritization analysis.

Table V-1 — Hazard Identification Results

Hazard Type	Planning Consideration
Flooding	Significant
Severe wind	Moderate
Severe winter storm	Moderate
Drought	Limited
Extreme heat	Limited
Hail storm	Limited
Landslides	Limited
Tornado	Limited
Wildfire	Limited
Earthquake	None

In order to focus on the most critical hazards that may affect the Planning District communities, the hazards assigned a level of *Significant* or *Moderate* will receive the most extensive attention in the remainder of this analysis, while those with a *Limited* planning consideration level will be discussed in more general terms. Those hazards with a planning level of *None* have not been addressed in this plan beyond this section. The level of *None* should be interpreted as not being critical enough to warrant further evaluation; however, these hazards should not be interpreted as having zero chance of occurrence or no impact.

As can be seen in Table VI-1, earthquakes have been designated with a hazard level of *None*, and will not be included in this analysis. An earthquake is the shaking of the ground's surface caused by movements of the plates beneath it. The Richmond region has experienced repeated small-scale earthquakes in recent years. Neither epicenter was located within the region but seismic experts from Virginia Tech have expressed concern to public officials regarding possible risks. City officials report that earthquake monitoring equipment was previously located in the city (implicitly acknowledging vulnerability) but the equipment was moved by the United States Geologic Survey to higher risk area in the western United States.

Though there have been historical occurrences of earthquakes that have affected the Richmond region, the probability and impact is low enough for the overall risk to be considered "none" at a planning level. This reasoning is supported by a loss estimate created using FEMA's Hazards US, multi-hazard loss estimation software (HAZUS-MH) that shows annualized losses for the region as about $1 million. This number is compared to annualized losses from wind events at $14 million.

Because some of the types of the hazards included in the hazard identification exercise are similar, some hazards will be discussed simultaneously later in this analysis. For instance, the severe winds section encompasses hurricanes and other tropical disturbances, tornadoes and thunderstorms. A detailed discussion of the potential hazards that have been identified as significant and moderate events is provided in the sections that follow. A brief discussion of the limited events also is included.

The number of Presidentially-disasters can give an insight into the number of major events that affect a community. Since 1969, the Richmond region has experienced nine Presidentially-declared disasters. Table V-2 provides a breakdown on the count by jurisdiction.

Table V-2 – Presidentially-Declared Disasters Since 1969	
Jurisdiction	Count
Charles City County	5
Goochland County	4
Hanover County (including the Town of Ashland)	9
Henrico County	9
New Kent County	6
Powhatan County	7
City of Richmond	8
Source: VDEM - http://www.vdem.state.va.us/library/dishist.cfm	

Flooding

The most significant natural hazard to affect the Richmond Regional Planning District is flooding. The Planning District is relatively flat, falling in the Piedmont and Coastal Plain regions. The western portion of the study area is characterized by a more rolling topography but the part east of the Falls Line can be locally quite rugged where short, high gradient streams have incised steep ravines.

Several rivers flow through the planning district including the James River, York River, Pamunkey River, Chickahominy River, Appomattox River and North Anna River. Numerous creeks crisscross the study area. None of the shorelines within the study area fall into the coastal high hazard zone as defined by FEMA (also known as the "V" zone). Figure V-1 shows the watersheds in the Richmond region.

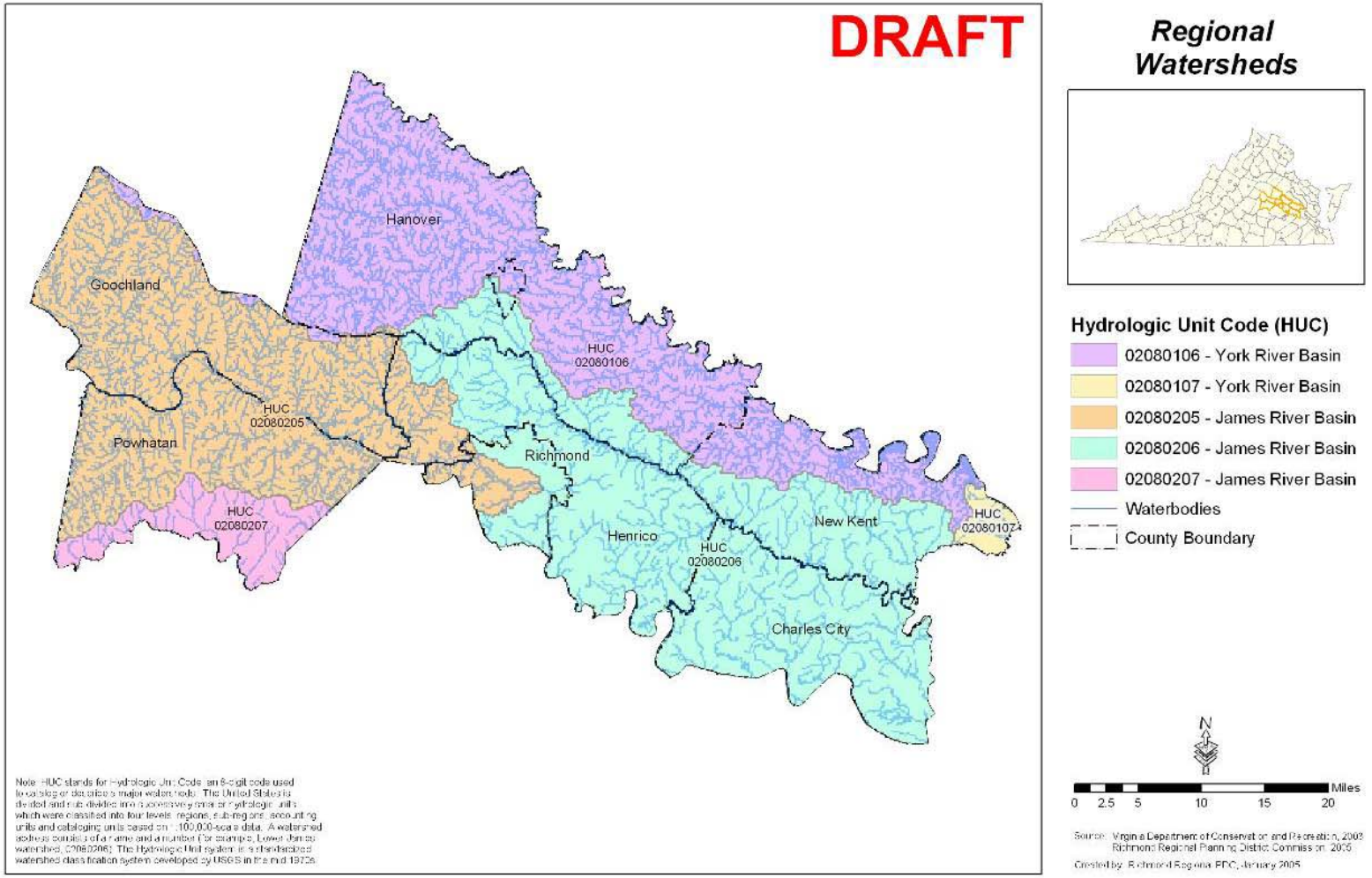

Figure V-1 — Richmond Regional Watersheds

Hazard History

Flooding has been a fact of life for the Richmond region since its settlement by English colonists. The first major recorded flood affected Henrico County and the City of Richmond in May 1771. One hundred years later, a massive flood collapsed the third floor of the Virginia Capitol, killing 60 and injuring 250.[5]

Hurricanes are a frequent cause of flooding. A hurricane, which coincided with astronomical high tide, caused flooding in Charles City and New Kent counties in August 1933. September 5, 1935 saw "The Great Labor Day Hurricane," whose heavy rains fell over central Virginia and resulted in a major flood on the James River in Richmond. Water level at the Richmond locks reached 23.7 feet, which is over 15 feet above flood stage.[6]

Two hurricanes, Connie and Diane, passed through the study area within days of each other in August 1955. Rain from the two storms set records for the month of August over central and northern Virginia and caused flooding from Virginia through Pennsylvania. Richmond received 8.85 inches from Hurricane Connie alone.[7]

The next major hurricane to cause flooding was Hurricane Camille in August 1969. Major flooding followed as the bulge of water moved down the James River into Richmond. Statewide damage was estimated at 113 million dollars (1969 dollars). The impact of this storm, along with Hurricane Agnes, damaged the Main Street Station to the point that it was closed by Amtrak on October 15, 1975.[8] In addition, the devastating floods of Agnes inundated the water supply and sewage treatment plants. Electric and gas plants also were flooded. Only one of the five bridges crossing the James was usable and the downtown section was closed for several days. Industry and businesses suffered immense damage.[9]

The records are quiet until 1995 when flooding affected Henrico and Goochland counties in January, June, and September. The June floods were caused by very heavy rainfall from slow moving thunderstorms. The rain caused small streams and creeks to overflow their banks and

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[5] FEMA. *Flood Insurance Study. City of Richmond, VA.* July 20, 1998.

Richmond Metropolitan Convention and Visitors Bureau. *About Richmond.* Retrieved from http://www.richmondva.org/HTML/About_Richmond/History.lasso.

SHG Resources. *Chronological History of Virginia.* Retrieved from http://www.shgresources.com/va/timeline/.

[6] *Flood Insurance Study. City of Richmond, VA. Virginia Hurricanes.*
[7] *Virginia Hurricanes.*
[8] *About Richmond.*
[9] *Flood Insurance Study. City of Richmond, VA. Virginia Hurricanes.*

led to the closure of Virginia Route 6 and more than a dozen secondary roads. The rain damaged more than 4,500 acres of crop and pasture.[10]

A September 1996 flood led to the death of one woman and the injury of another woman in the City of Richmond. Four inches of rain fell within five hours in eastern Henrico County causing flooding of roadways and poor drainage areas. This heavy rainfall combined with a five-foot-deep drainage ditch filled with water contributed to the death and injury of two Richmond sisters, when their vehicle ran into water two feet deep near the intersection of Yeadon Road and Barrington Road. In addition, local police reported Highway 665 (New Kent County) was closed due to high water.[11]

The Richmond region did not escape the affects of Hurricane Floyd, which devastated North Carolina and the southeastern part of Virginia. The storm caused approximately $1.5 million in damages in the study area, mainly in the City of Richmond and Hanover, Henrico, and New Kent counties.[12]

Multiple flood events affected the study region in 2000. Heavy rain in July overwhelmed storm drains on Maury Street in south Richmond and flooded the basement of the Richmond Department of Public Utilities' Field Operations and Maintenance Facility. As much as five feet of water filled the 10,000 square foot basement and damaged several computers and internal department records. In addition, ten inches of water was reported across Belt Boulevard between Hull Street and Midlothian Turnpike. Two weeks later, another storm left standing water in Shockoe Bottom and flooded numerous roads in Hanover County. A week later, more rain caused the closure of the intersection of West Canal and South Adams Streets in downtown Richmond. High water also closed Bainbridge Street at 20th Street. In September, slow-moving thunderstorms caused the flooding of the intersection of Routes 522 and 60 near Powhatan.[13]

Heavy rain in 2001 caused the closure of Interstate 95 at the Broad Street underpass. Roads also were closed in New Kent County after floods in June 2001.[14]

The next big event was in September 2003 when Hurricane Isabel caused strong winds and rain as far inland as the metropolitan Richmond area. Statewide, $257 million in state and federal assistance was approved for individuals and businesses that suffered damage from

[10] NOAA/National Climatic Data Center. *U.S. Storm Event Database*. Retrieved from http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms.
[11] *U.S. Storm Event Database.*
[12] FEMA.
[13] *U.S. Storm Event Database.*
[14] *U.S. Storm Event Database.*

Hurricane Isabel. Hurricane Isabel storm damage in the Commonwealth reached an estimated $1.6 billion, with the final tally expected to be higher.[15]

On June 16, 2004, Powhatan County experienced over five inches of rainfall in a one-hour period in the watershed that feeds Powhatan Lakes, causing the dams to break. The dam and resulting lakes were built over one hundred years ago and are maintained by the Virginia Department of Game and Inland Fisheries. Though the two, thirty-five acre lakes were lost, little to no other damage was done. The area around the lakes is sparsely populated and the surrounding land has no buildings in the floodplain. The Department of Game and Inland Fisheries plans to rebuild both dams. Reconstruction is forecasted to take over two years, with the bid process to take about a year. The dams and lakes were insured with a $1,000 deductible and the rebuilding estimates are just over 1 million dollars.

At the time of this report, the most recent major event was Tropical Depression Gaston in August 2004. This weather system brought as much as 14 inches of rain to some areas. Reports were that flooding exceeded the 500-year recurrence interval.[16] There were 7 reported deaths in the City of Richmond, and Hanover and Henrico counties. Homes, apartments, and businesses in low-lying areas were flooded and many streets were impassable. Particularly hard hit was the Shockoe Bottom area in the City of Richmond. In the City of Richmond, Chesterfield County and Henrico County, an estimated 350 housing units were either destroyed or received major damage, including single-family homes, apartment units and mobile homes. More than 230 businesses were affected by floodwaters. Numerous small bridges in the City of Richmond, and Henrico, Hanover, and New Kent counties were washed out.[17] Over $6.3 million in disaster assistance grants has been given to local governments in the study area and over $12 million in grants and loans to residents (including residents of Chesterfield County and the City of Colonial Heights).[18]

Appendix D contains a full listing of the known historical flood events in the Richmond region. Table V-3 provides the count of recorded flood events by jurisdiction. It should be noted that these results represent only those events for which records could be found, therefore some, particularly local, events may not be included in this table.

[15] Virginia Department of Emergency Management.
[16] United States Geological Survey. *Precipitation and flooding from Tropical Storm Gaston in Virginia* Retrieved from http://va.water.usgs.gov/gaston_flood.htm.
[17] United States Geological Survey. *Precipitation and flooding from Tropical Storm Gaston in Virginia* Retrieved from http://va.water.usgs.gov/gaston_flood.htm.
[18] FEMA. Virginia Department of Emergency Management

Table V-3 – Count of Flood Events by Jurisdiction	
Jurisdiction	Count
Charles City County	12
Goochland County	17
Hanover County (including the Town of Ashland)	34
Henrico County	32
New Kent County	20
Powhatan County	30
City of Richmond	42
Sources: NOAA/National Climatic Data Center. U.S. Storm Event Database; FEMA/Flood Insurance Study; VDEM; SHELDUS	

A majority of the flood events in Charles City and New Kent counties have been caused due to hurricanes, while the City of Richmond and Henrico County are more vulnerable to flooding caused by high rainfall.

Recurrence intervals can be estimated using the number of flood occurrences over a period of time. There have been 63 recorded events that have caused notable floods in the past 104 years, for a flood recurrence interval of approximately once every .6 years or about every 7 months.

Hazard Profile

The majority of the flooding in the Richmond Regional Planning District is the by-product of hurricanes and tropical storms. Flooding also may occur following a period of intense or sustained rainfall. The floods caused by Tropical Storm Gaston are characteristic of this type of flooding. The intense rainfall combined with the inability of the City of Richmond's stormwater system to handle the increased flow led to a great deal of damage in the Shockoe Bottom area. The duration of flood events vary depending on the specific characteristics of the rain event. Floodwaters generally recede rapidly once the rain event has ended, but can last from a few hours to a few days.

Flood-producing storms can occur throughout the year. Historically, the most common months for significant flooding have been August and September, which is the height of the hurricane season.

Secondary Effects

If a significant flood event occurs, there is a potential for a variety of secondary impacts. Some of the most common secondary effects of flooding are impacts to infrastructure and utilities such as roadways, water service, and wastewater treatment. Many of the roadways in the Planning District are vulnerable to damage due to floodwaters. The effect of flood damages to roadways can limit access to areas, cutting off some residents from emergency services as well as other essential services.

Hazard Areas

The portions of the Planning District most susceptible to flooding are those directly adjacent to the areas' major waterways, however, flooding can occur along the smaller tributaries throughout the area. Much of the land in the region's floodplains is designated for agricultural uses. Some localities, however, allow residential uses within agriculture areas. Table V-4 shows the dominant use by jurisdiction.

Table V-4 – Land Use in the Floodplain

Jurisdiction	Dominant Use
Charles City County	Agriculture/Forest
Goochland County	Agriculture
Hanover County	Agriculture
Town of Ashland	Agriculture/Rural
Henrico County	Vacant/Residential
New Kent County	Conservation
Powhatan County	Agriculture
City of Richmond	Vacant/Industrial
Source: GIS analysis by RRPDC	

FEMA, through the National Flood Insurance Program (NFIP), has developed Flood Insurance Rate Maps (FIRMs) that identify flood zones through detailed hydrologic and hydraulic studies. These flood zones represent the areas susceptible to the 1% annual chance flood, or 100-year flood. Whenever possible, FEMA also determines a Base Flood Elevation (BFE) for the 100-year floodplain, which is the calculated elevation of flooding during this event. The BFE is a commonly used standard level for determining flood risk, and managing potential floodplain development. Although each specific flood event is different, these maps

provide a more definitive representation of the highest flood risks in the communities. The specific flood hazard areas in each of the jurisdictions are described below.

Flood Maps

Historically, FEMA Flood Insurance Rate Maps (FIRMs) have only been available as paper copy maps and not in digital format. However, in recent years FEMA has developed digital versions of the FIRMs called "Q3 flood maps". These Q3 maps can be incorporated into a geographic information system to be used in analyzing flood risk. Q3 data does not exist for any of the communities in the study area. In order to be able to do a flood risk analysis and vulnerability assessment, the Richmond Regional Planning District Commission digitized paper FIRMs.

Vulnerability Analysis

Flooding impacts a community to the degree it affects the lives of its citizens and the community functions overall. Therefore, the most vulnerable areas of a community will be those most affected by floodwaters in terms of potential loss of life, damages to homes and businesses, and disruption of community services and utilities. For example, an area with a highly developed floodplain is significantly more vulnerable to the impacts of flooding than a rural or undeveloped floodplain where potential floodwaters would have less impact on the community.

A number of factors contribute to the relative vulnerabilities of certain areas in the floodplain. Development, or the presence of people and property in the hazardous areas, is a critical factor in determining vulnerability to flooding. Additional factors that contribute to flood vulnerability range from specific characteristics of the floodplain to characteristics of the structures located within the floodplain. The following is a brief discussion of some of these factors and how they may relate to the area.

- **Flood depth:** The greater the depth of flooding, the higher the potential for significant damages.

- **Flood duration:** The longer duration of time that floodwaters are in contact with building components such as structural members, interior finishes, and mechanical equipment, the greater the potential for damage. Floodwaters may linger because of the low relief of the area but the degree varies.

- **Velocity:** Flowing water exerts forces on the structural members of a building, increasing the likelihood of significant damage. A one-foot depth of water, flowing at a velocity of 5

feet per second or greater, can knock an adult over and cause significant scour around structures and roadways.[19]

- **Elevation:** The lowest possible point where floodwaters may enter a structure is the most significant factor contributing to its vulnerability to damage due to flooding. Data on the specific elevations of structures in the study area have not been compiled for use in this analysis.

- **Construction Type:** Certain types of construction are more resistant to the effects of floodwaters than others. Masonry buildings, constructed of brick or concrete blocks, are typically the most resistant to flood damages simply because masonry materials can be in contact with limited depths of flooding without sustaining significant damage. Wood frame structures are more susceptible to flood damage because the construction materials used are easily damaged when inundated with water. The type of construction throughout the Planning District varies from area to area.

Hazard Areas and Vulnerability Assessment by Jurisdiction

Charles City County

The areas along the James River and Chickahominy River shorelines of Charles City County are vulnerable to tidal flooding from major storms. The area also contains estuaries of the James River that are subject to tidal flooding on their lower reaches but fluvial flooding on their higher reaches. Mapsico, Morris, and Tomahund Creeks also have significant areas of floodplain.

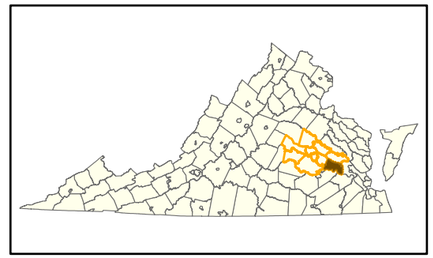
The stillwater elevation for the 100-year event along the James River and estuaries in Charles City County is 8.5 feet. For the Chickahominy River, the 100-year stillwater elevation also is 8.5 feet. In addition to the James and Chickahominy Rivers, there are numerous smaller tributaries in Charles City County including Queens Creek and Herring Creek. No portion of the shoreline is at risk to significant wave attack. Bulkheads, seawalls, and jetties are employed as means to protect against floods.[20]

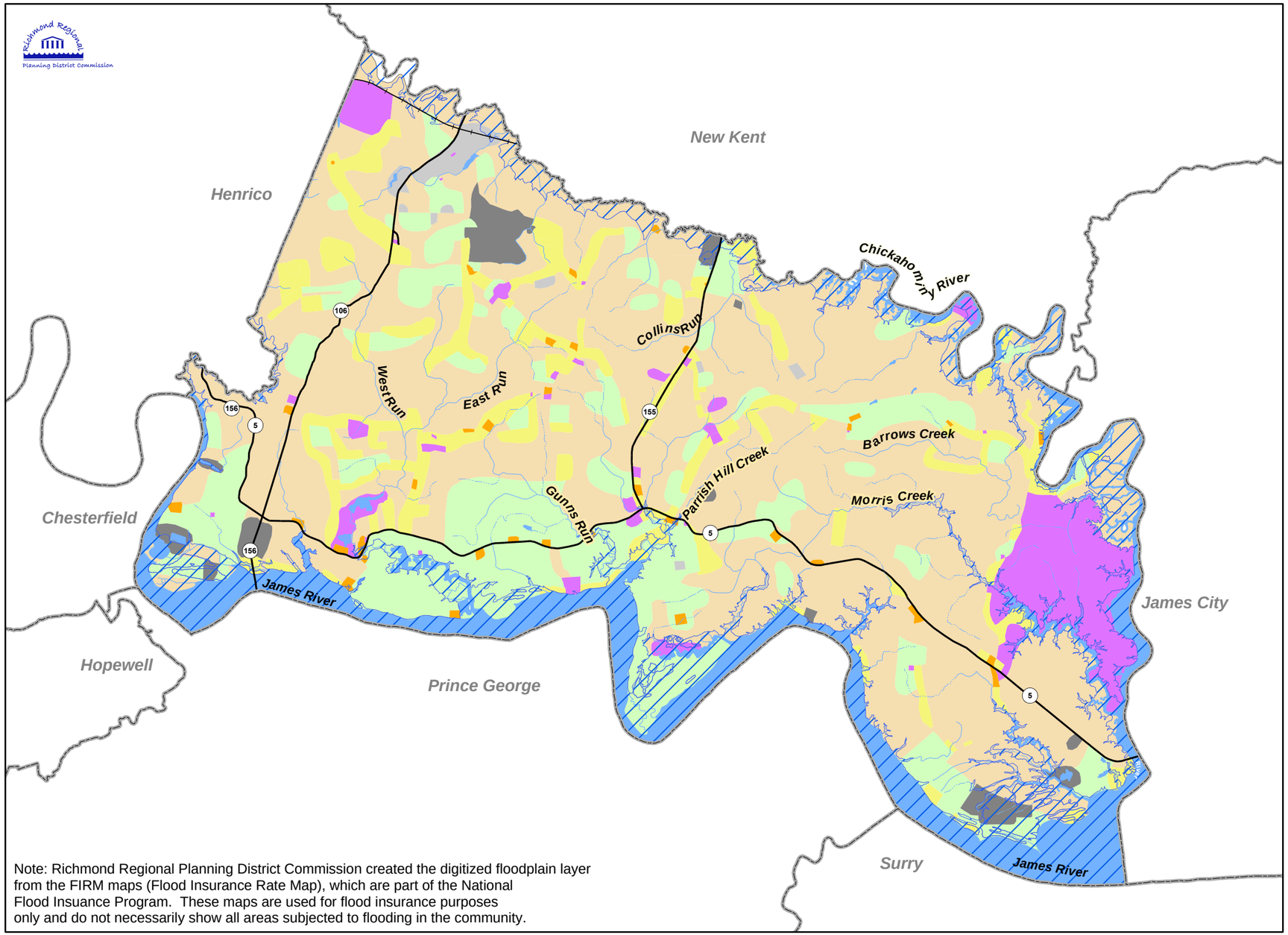
Q3 flood data is not available for Charles City County. However, the FIRM containing the portion of the floodplain along the James River and the Chickahominy River was digitized for use in this analysis. Figure V-2 shows the floodplain and existing land uses and Figure V-3 shows the floodplain and future land uses.

[19] FEMA. *Principles and Practices for Retrofitting Flood Prone Residential Buildings* (FEMA 259). June 2001.
[20] FEMA. *Flood Insurance Study. Charles City County, VA, Unincorporated Areas.* September 5, 1990.

Potential Flooding Impact on Existing Land Use Features

Charles City County





Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

- Agricultural
- Commercial
- Industrial (Light)
- Industrial (Heavy)
- Public / Semi-Public
- Residential
- Rural
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

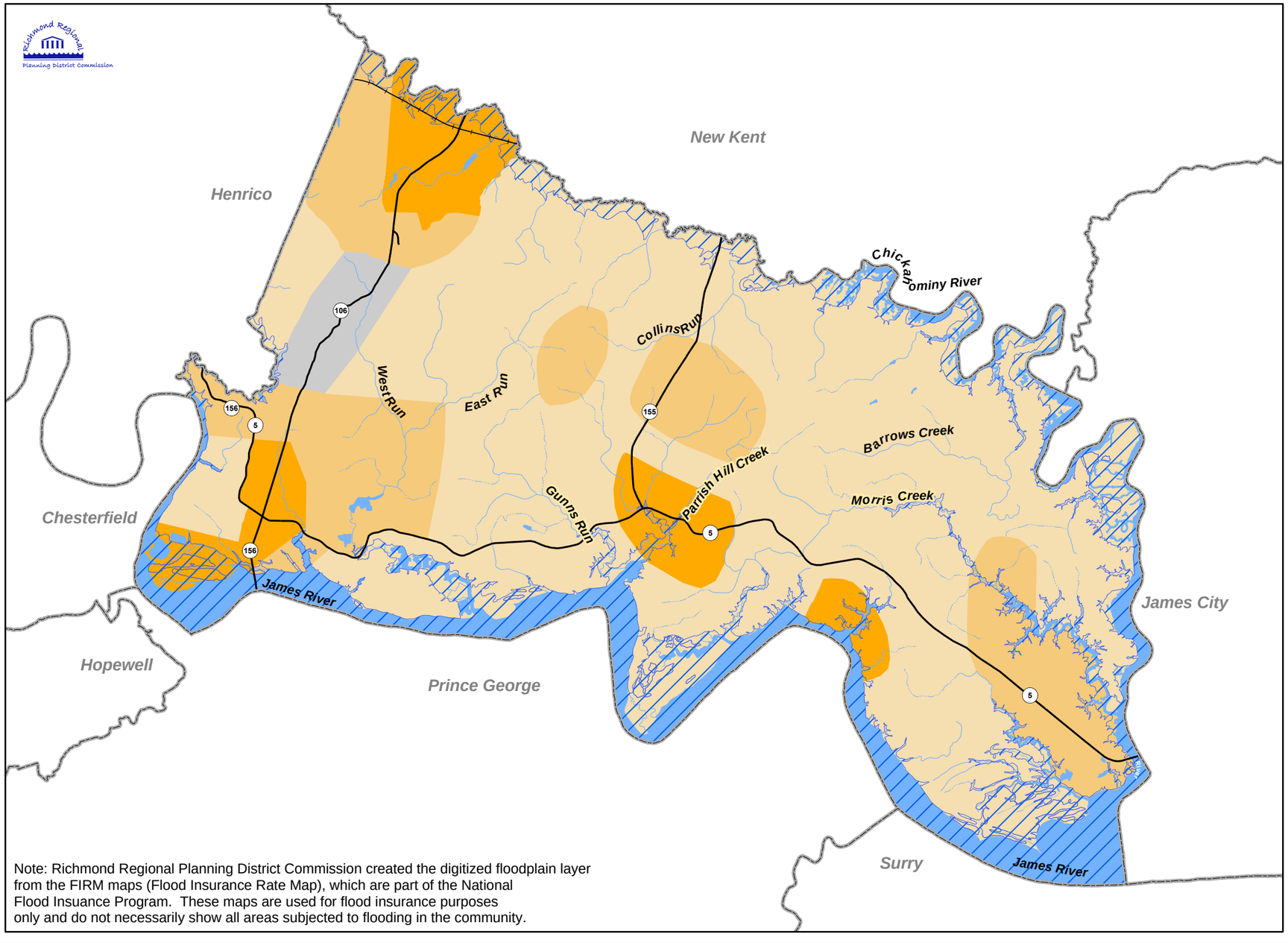
N

0 1 2 4 6 Miles

Source: US Census Bureau, 2000
Charles City County, 2004
National Flood Insurance Rate Map, September 5, 1993
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

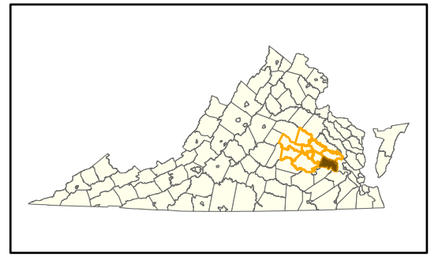
V-2 - Charles City County Floodplain and Existing Land Use



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Potential Flooding Impact on Future Land Use Features

Charles City County



- Industrial
- Local Delevopment Center
- Regional Development Center
- Rural Area
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

N

0 1 2 4 6 Miles

Source: US Census Bureau, 2000
Charles City County, 2004
National Flood Insurance Rate Map, September 5, 1993
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

V-3 - Charles City County Floodplain and Future Land Use

As seen in the maps, most of the floodplain currently is used for agricultural purposes. There is some rural and public land also located in the floodplain. The future land use map shows that planned uses for the majority of the floodplain is rural but some of the floodplain is slated as local or regional development center use. By using adequate site and building design standards, new development in the floodplain can be protected against flooding.

In north-central Charles City County, flood waters from Tropical Storm Gaston overtopped the bridge at Route 155, closing this route to New Kent County for about six months.[21] Tomahund Creek experiences frequent flooding that affects several homes but offers of assistance historically have been refused. Several homes along Route 618 also have experienced repeat flooding. Beaver dams are often the cause of flooding along creeks such as Parrish Hill Creek.

Known areas of recurrent flooding include three subdivisions along Rt.5 (John Tyler Memorial Highway) at the southeastern end of the county. These subdivisions are located near the Chickahominy River Bridge (a.k.a. Barrett's Ferry Bridge). This area is highlighted on Figure V-18 as Area #1.

To the north, there is extensive residential development along a bend in the Chickahominy that also experiences recurrent flooding. This area, known as Mount Airy, has numerous homes found along Old Neck Road and off of Wilcox Neck Road and The Glebe Lane. This area is highlighted on Figure V-18 as Area #2.

Exacerbating the flooding problem is lack of ditch maintenance. VDOT clears the side of the ditch next to the road but not the far side of the ditch. This allows remaining debris to block the ditch and hold water back until the pressure builds and breaks the debris dam, resulting in flooding.

The Harrison Point subdivision, along the James River, also experiences recurrent flooding. In addition, the river banks experience substantial erosion from storm events. This area is highlighted on Figure V-18 as Area #3.

In the northwest part of the county, along State Road 106, new road construction acts as a dam and has created additional flooding problems. This area is highlighted on Figure V-18 as Area #4. In addition, Sturgeon Point Road historically flooded but the road was elevated and mitigation ponds were built to retain water from Morris Creek.

[21] Virginia Department of Transportation. *VDOT Reopens Route 155 Bridge Over Chickahominy River Canal.* (2005). Retrieved from http://www.virginiadot.org/infoservice/news/newsrelease.asp?ID=RICH-2605 on July 25, 2005.

Walkers Dam across the Chickahominy River in the north-central part of the county also may pose a threat to upriver residential development. The dam is used to create a water impoundment site to supply drinking water for the City of Newport News. According to local officials, the dam is either incapable of being used as a device to lower water level in the upstream Chickahominy Lake or is not used for this purpose for flood control. This area is highlighted on Figure V-18 as Area #5.

Local officials also report that there are no NOAA/NWS stream gauges on the Chickahominy River. There may be one or two gauges monitored by state agencies but this information is typically not relayed to the NWS, therefore, there is no flooding or crest modeling information provided. This lack of information hinders response actions by the county.

Goochland County

In addition to the James River, there are numerous smaller tributaries in Goochland County including Big Tuckahoe, Byrd, Little Byrd, Big Lickinghole, Little Lickinghole, Courthouse, Genito, and Beaverdam Creeks and Readers Branch.

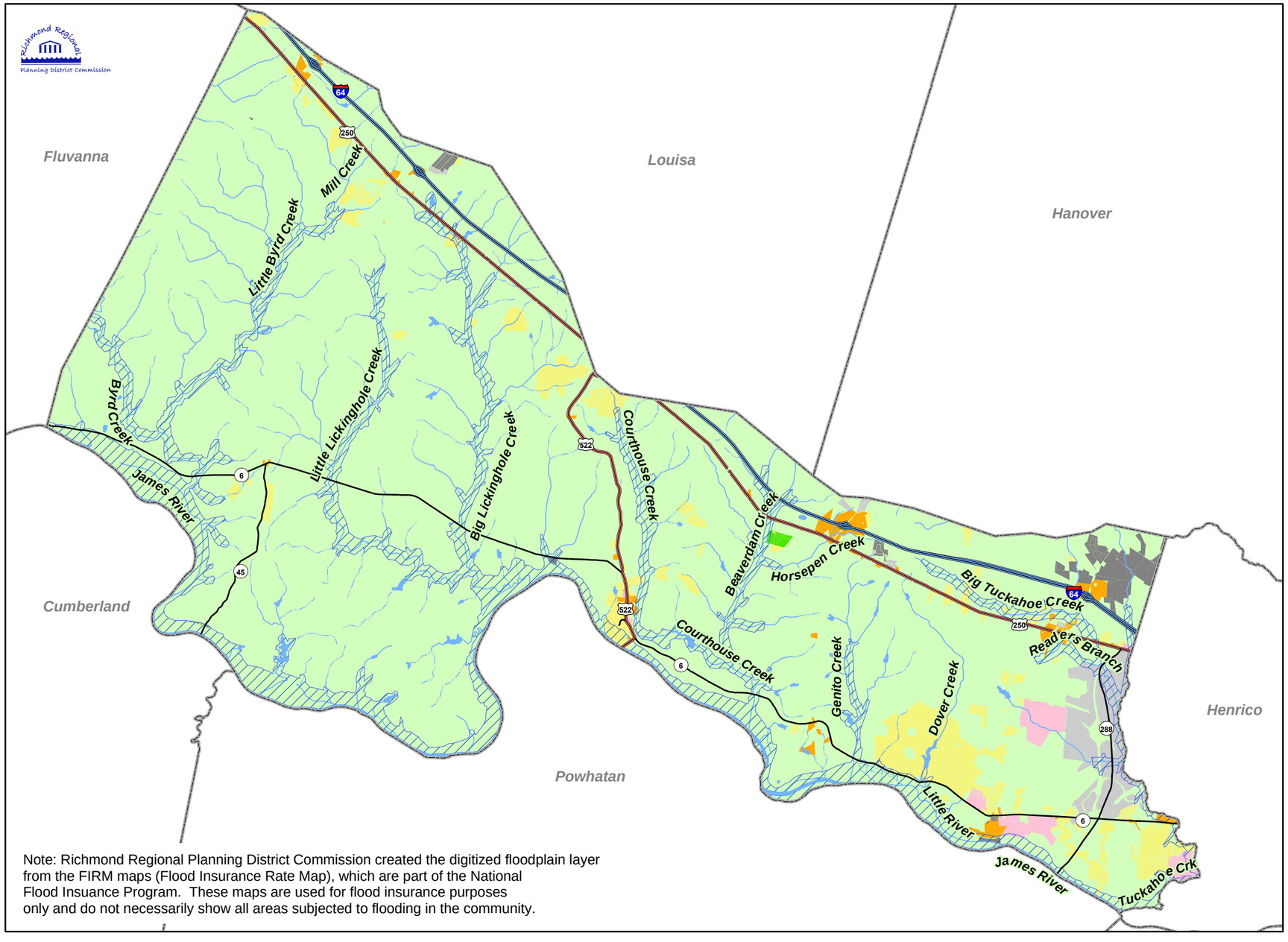
The floodplains of the James River described in the Flood Insurance Study range from 200 to 5,400 feet in width. Flooding on Tuckahoe Creek is minimal. Flooding results either from intense, short-duration rainfall over the area or from backwater from the James River.

The Base Flood Elevation (BFE) ranges from 146.5 feet in the western portion of the county to 212.2 feet in the eastern portions of the county. BFEs on Tuckahoe Creek range from 135.2 feet to 151.8 feet. All BFEs are cited with the floodway included in the analysis.[22]

Q3 flood data is not available for Goochland County. However, the FIRM containing the portion of the floodplain along the James River and the lower reaches of Tuckahoe Creek was digitized for use in this analysis. Figure V-4 shows the floodplain and the current land use in the county and Figure V-5 shows the future land use and floodplain.

As seen on the maps, the majority of land use currently located in the floodplain is agricultural/rural use. A small amount of mixed use and light industrial also appears to be in the floodplain. According to the future land use map, the majority of the floodplain will remain agricultural/rural though there are new residential uses also expected in the floodplain. By using adequate site and building design standards, new development in the floodplain can be protected against flooding. In addition, some light industrial areas are planned to transfer to agriculture or rural use.

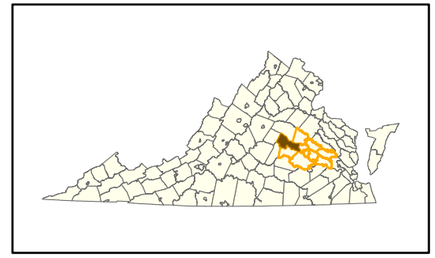
[22] FEMA. *Flood Insurance Study. Goochland County, VA, Unincorporated Area*s. September 1978.



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Potential Flooding Impact on Existing Land Use Features

Goochland County



- Agricultural / Rural (various)
- Business / Commercial
- Industrial (Limited)
- Industrial (General)
- Mixed Use (various)
- Open Space / Recreation
- Residential (various)
- Interstate
- US Primary Highway
- State Primary Highway
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

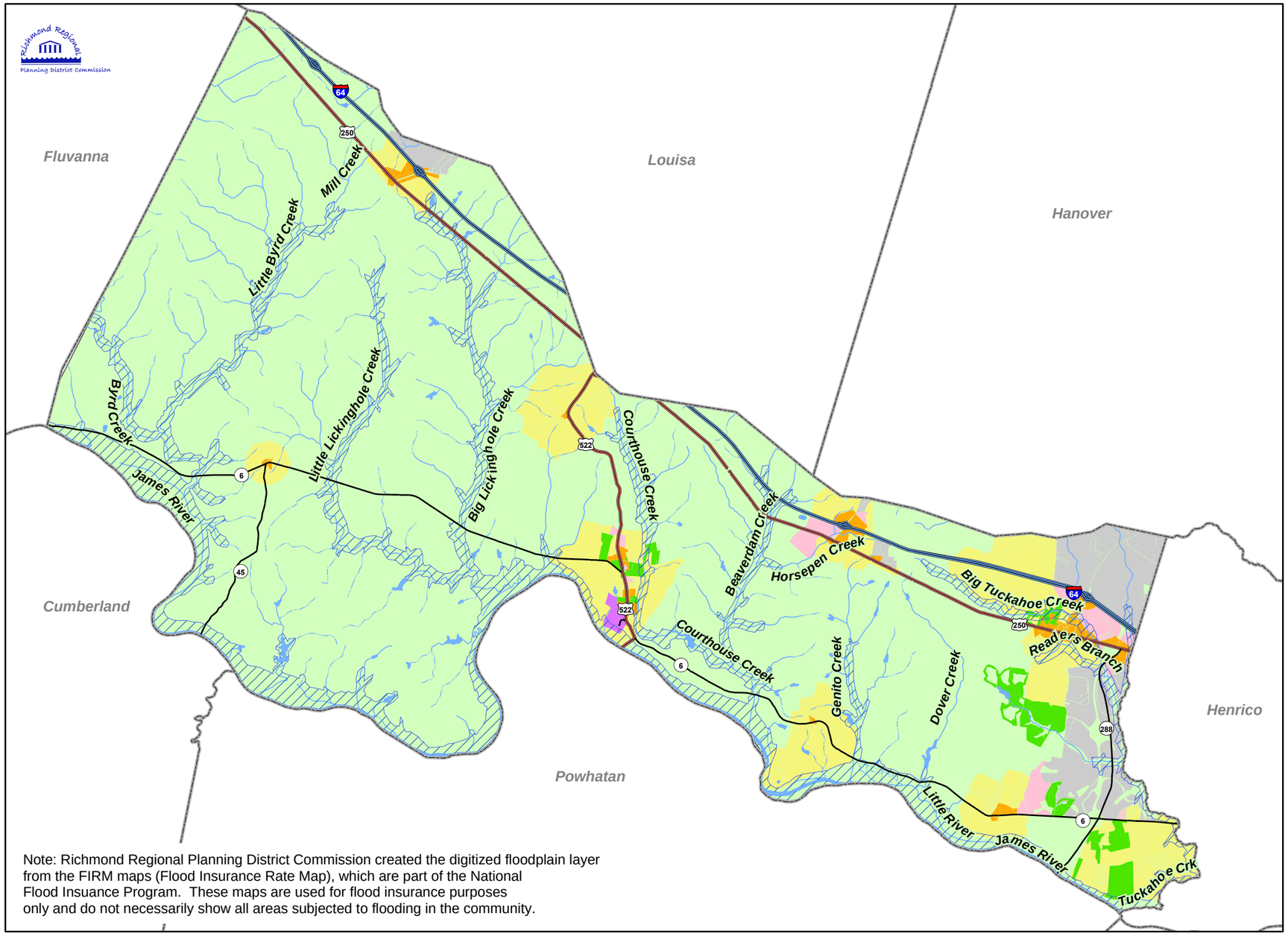
N

0 1 2 4 6 Miles

Source: US Census Bureau, 2000
Charles City County, 2004
National Flood Insurance Rate Map, September 5, 1993
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

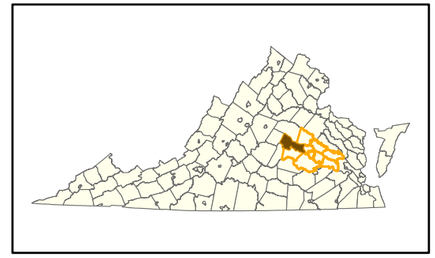
V-4 - Goochland County Floodplain and Existing Land Use



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Potential Flooding Impact on Future Land Use Features

Goochland County



- Agricultural / Rural (various)
- Business / Commercial
- Industrial (limited and general)
- Mixed Use (various)
- Open Space / Recreation
- Residential (various)
- Public / Institutional
- Interstate
- US Primary Highway
- State Primary Highway
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

N

0 1 2 4 6 Miles

Source: US Census Bureau, 2000
Charles City County, 2004
National Flood Insurance Rate Map, September 5, 1993
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

V-5 - Goochland County Floodplain and Future Land Use

Goochland's water supply is provided by Henrico County and the Virginia Department of Corrections (in the eastern and western portions of the county respectively). In the eastern portion of the county, sewage is sent to Richmond for treatment, while in the western portion of the county it is sent to the Virginia Department of Corrections. There is concern that the City of Richmond would not be able to receive and treat sewage from Goochland County during a disaster. This could result in sewage backing up from the system into homes and businesses.

The floodplain regulations in Goochland County have traditionally limited development in the floodplain. Farming is a major use in the floodplain so equipment, crops, and animals are at risk. The county works with the Virginia Department of Agricultural and Consumer Services to notify approximately sixteen farmers that are located in the floodplain of impending flooding.

A number of roads in Goochland County are subject to repeated flooding. The bridge at Routes 610 and 684 is often closed due to high water. Route 687 (Danieltown Road) in the Camp Winger area is subject to flooding as is Route 608 (Davis Mill Road) in the Hundred Brothers area. Flood waters often block access on Old Lower Tuckahoe Road, which is a private road. Numerous people may be trapped in their homes when this road is blocked.

Debris tends to collect at the bridge on Route 603 (Elk Island Road) but this issue is being addressed as part of the post-Isabel repair program. Route 613 (Riddles Bridge Road), also is being repaired as part of work needed after Hurricane Isabel. Water often blocked a curve of Route 645 but the road has been elevated to address this issue. Cedar Plains Road was subject to flooding from Big Lickinghole Creek but the problem has been addressed.

Hanover County (including the Town of Ashland)

A large part of the floodplain in Hanover County can be found along the Chickahominy and North Anna Rivers. Numerous smaller tributaries in Hanover County also have 100-year floodplains including Beaverdam, Totopomony, and Matadequin, Mechumps Creeks, Bull and Stony Runs, and the South Anna, Little, and Pamunkey Rivers.

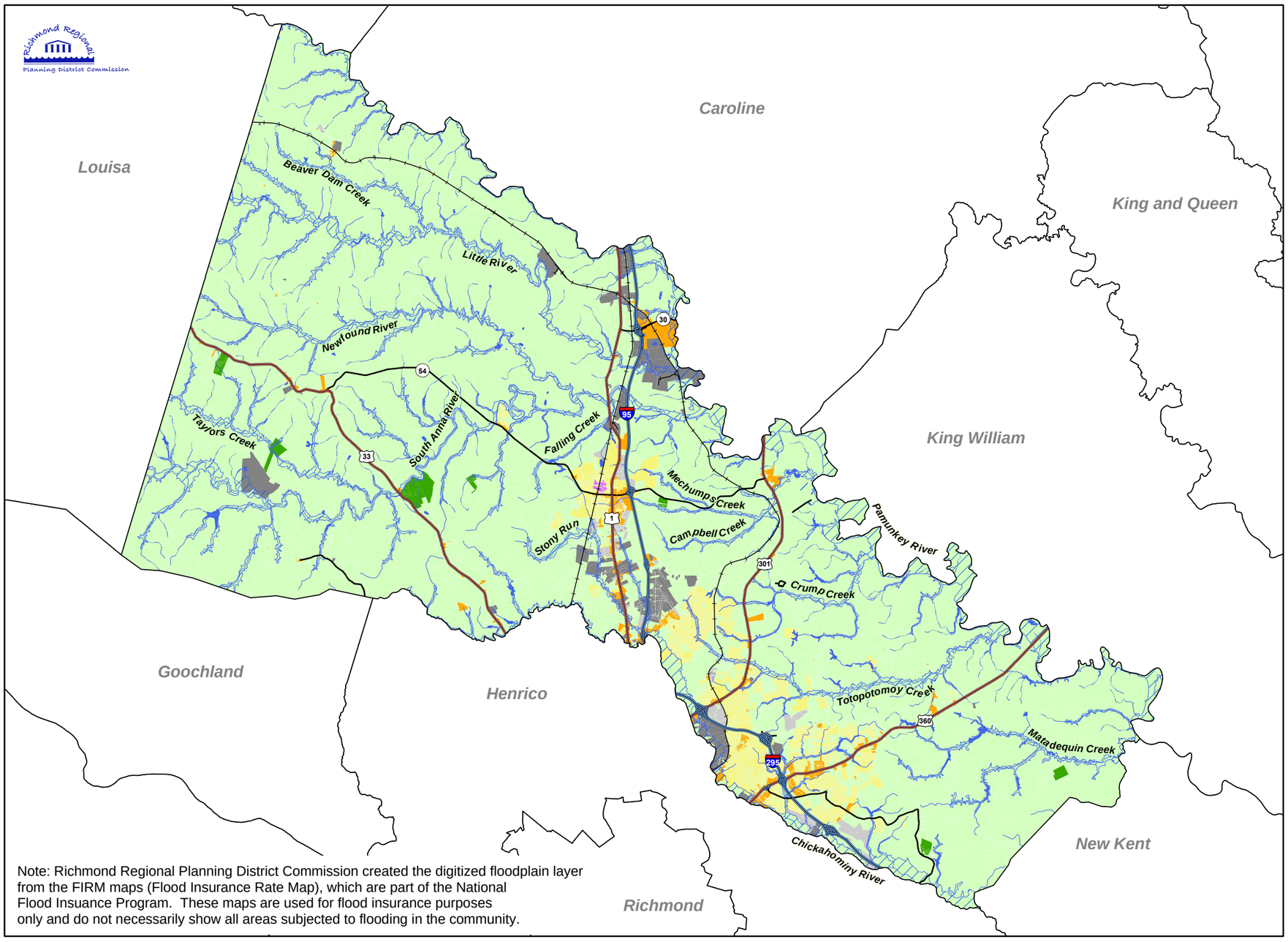
In the western portion of the county, the waterways flow through steep and narrow valleys but as the waterways cross the Falls Line, the floodplain becomes wider and the rivers and creeks become more sluggish. Smaller streams are subject to flooding by local storm systems. In general, the slope of the land is great enough to carry rain water away and prevent flooding.

The Base Flood Elevation (BFE) ranges from 78 feet in the western portion of the county to 208 feet in the eastern portions of the county. Along Beaverdam Creek, the BFEs range from 100 feet to 152 feet. BFEs on Stony Run range from 161 feet to 211 feet.[23]

Q3 flood data is not available for Hanover County. However, the FIRM was digitized for use in this analysis. Figure V-6 shows the 100-year floodplain and existing land uses. Figure V-7 shows the 100-year floodplain and future land uses. While the floodplains in Hanover County are not typically very wide, the mapped floodplain extends over a considerable amount of the county because of the numerous streams that crisscross the county. From Figure V-6, it can be seen that the majority of land within the floodplain is used for agricultural or rural purposes. The Future Land Use Map, in Figure V-7, shows that while some of the floodplain will remain in industrial or residential uses, portions of it will revert to agricultural or rural uses.

Only a small portion of the Town of Ashland is located in the 100-year floodplain, as can be seen in Figure V-8. Most of this floodplain land is currently being used for either industrial or rural/agricultural uses. Figure V-9 shows the 100-year floodplain and the expected future uses based on the town's comprehensive plan. As seen on the map, most of the floodplain is planned for industrial uses though some of it is planned for various residential uses.

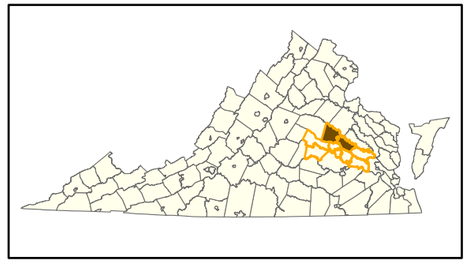
[23] FEMA. *Flood Insurance Study. Hanover County, VA, Unincorporated Areas.* March 2, 1981.



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Potential Flooding Impact on Existing Land Use Features

Hanover County



- Agricultural / Rural Land
- Business / Commercial
- Industry (Light)
- Industry (Heavy)
- Institutional
- Mixed Use
- Residential
- Rural Conservation
- Interstate
- US Primary Highway
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

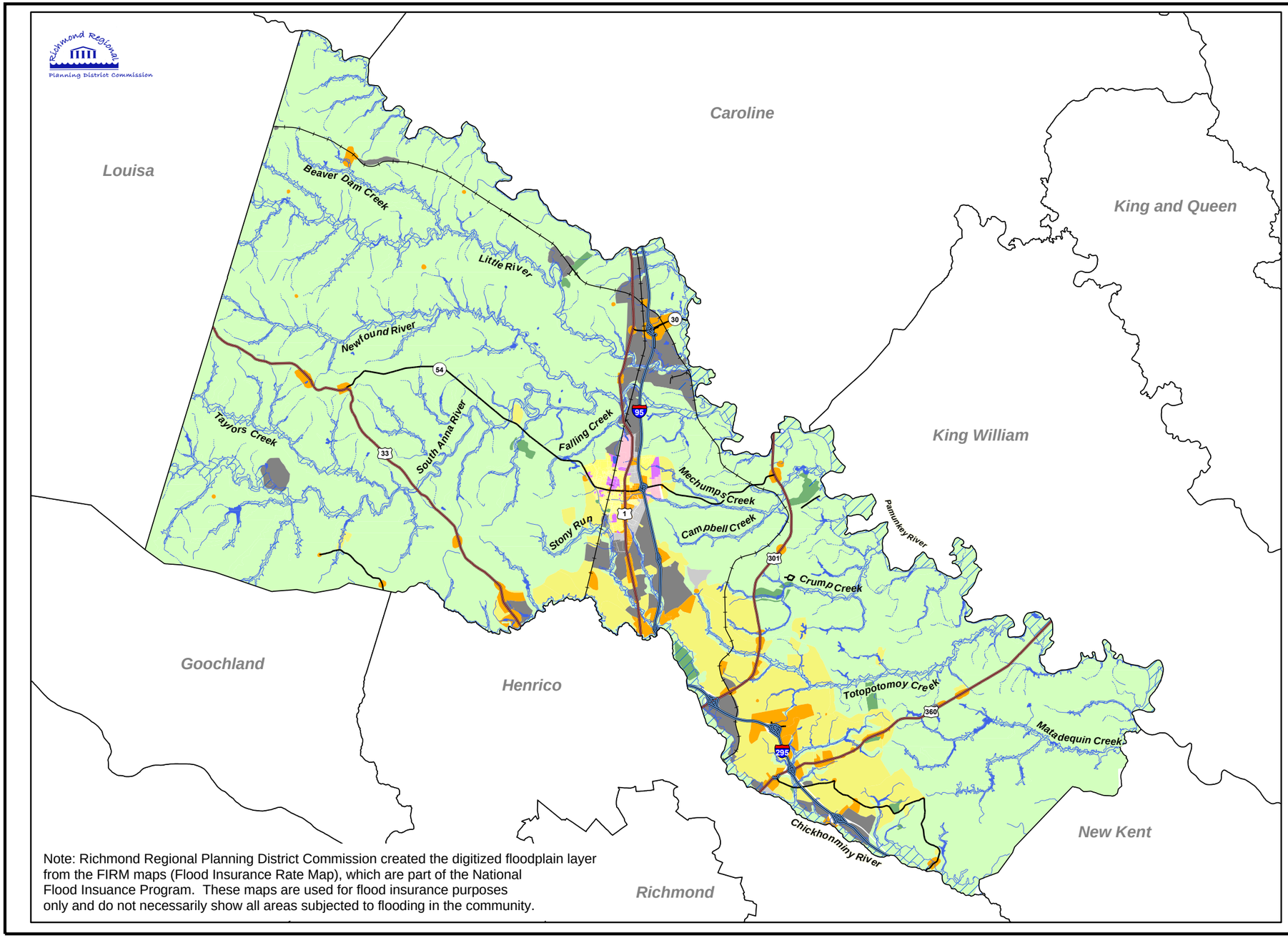
N

0 2 4 8 12 Miles

Source: US Census Bureau, 2000
Hanover County, 2004
National Flood Insurance Rate Map, March 1979
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

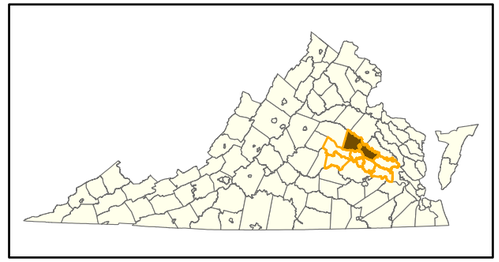
V-6 - Hanover County Floodplain and Existing Land Use



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Potential Flooding Impact on Future Land Use Features

Hanover County



- Agriculture / Rural Land
- Business / Commercial
- Industrial (Light)
- Industrial (Heavy)
- Residential
- Rural Conservation
- Interstate
- US Primary Highway
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

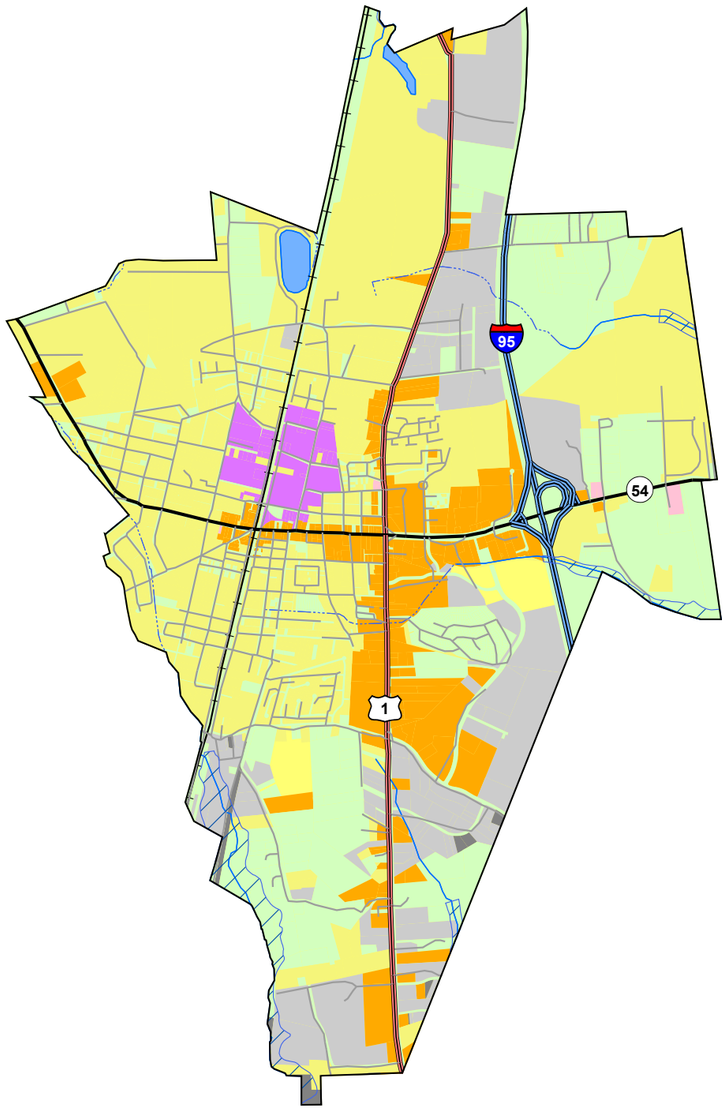
N

0 2 4 8 12 Miles

Source: US Census Bureau, 2000
Hanover County, 2004
National Flood Insurance Rate Map, March 1979
Richmond Regional Planning District Commission, 2004

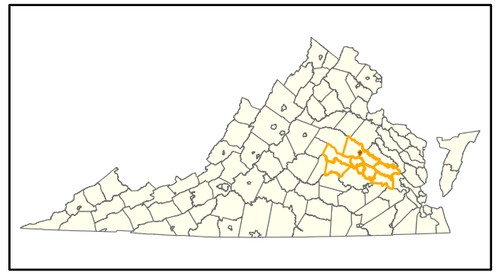
Created by: Richmond Regional PDC, November 2005

V-7 - Hanover County Floodplain and Future Land Use



Potential Flooding Impact on Existing Land Use Features

Town of Ashland



- Agricultural / Rural Land
- Business / Commercial
- Industry (Light)
- Industry (Heavy)
- Institutional
- Mixed Use
- Residential
- Rural Conservation
- Interstate
- US Primary Highway
- State Primary Highway
- Secondary Road
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

N

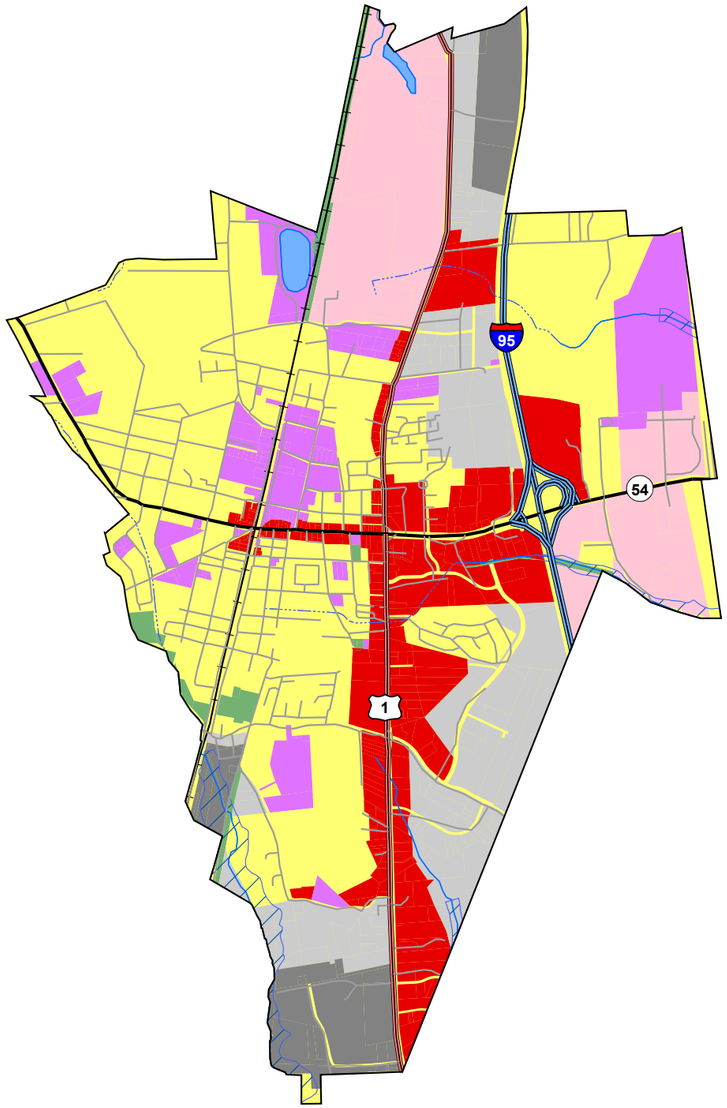
0 0.3 0.6 1.2 1.8 Miles

Source: US Census Bureau, 2000
Hanover County, 2004
National Flood Insurance Rate Map, March 1979
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

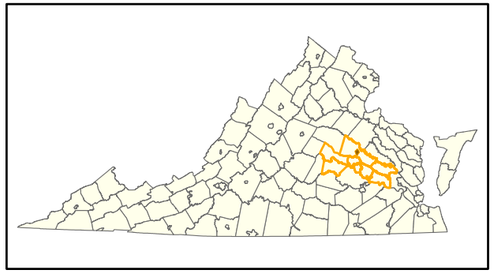
Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

V-8 - Town of Ashland Floodplain and Existing Land Use



Potential Flooding Impact on Future Land Use Features

Town of Ashland



- Business / Commerical
- Industry (Light)
- Industry (Heavy)
- Residential (various)
- Public / Institutional
- Mixed Use
- Rural Conservation
- Interstate
- US Primary Highway
- State Primary Highway
- Secondary Road
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

N

0 0.3 0.6 1.2 1.8 Miles

Source: US Census Bureau, 2000
Hanover County, 2004
National Flood Insurance Rate Map, March 1979
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

V-9 - Town of Ashland Floodplain and Future Land Use

As part of a redevelopment project, Mechanicsville is building a public park in the floodplain. Several businesses will be located on the fringe of the floodplain. This project should be monitored to ensure that no structures are placed at risk.

The Doswell water treatment plant is located on the North Anna River. If it were to lose power, the impacts could be substantial. The Oak Hill Estates pump station is subject to overflow; the effects are mainly felt by the Town of Ashland.

Spring Road, in the western part of the county, experiences recurrent flooding from Turkey and Taylor Creeks. Water also ponds at Meadowbridge Road and Route 360 blocking this major thoroughfare. The county club retention pond threatens the Route 54 and South Anna intersection.

In addition, the county experienced a number of road closures after Tropical Storm Gaston. Bridges and roads were washed out, sink holes formed in numerous places, and high water blocked roads. A full list of affected roads is in Appendix E.

Henrico County

The James River is the main source of flooding in Henrico County. The Chickahominy River is the north border of the county and also has extensive floodplains. There are numerous smaller tributaries in Henrico County including Tuckahoe, Little Tuckahoe, Gillies and Hungary Creeks, Stony Run and North Run, Upham Brook, and Rocky Branch. Many of the small streams are suburban in nature and have great flood potential because of the amount of development in their drainage area.

The low-lying areas adjacent to the James River are subject to periodic flooding. Flood problems on the other streams are often caused by intense, short duration rainfall or by backwater from the James River. The Flood Insurance Study calls attention to flooding in the Tuckahoe, Gillies, and North Run watersheds that is aggravated by limited openings in highway and railroad fills, or areas that have been filled in with earth or other materials to change the contour of the land or create an embankment. This study was conducted by the Federal Insurance Administration (part of the Federal Emergency Management Agency) in the early 1980s so these issues may have been addressed already. No Flood Insurance Study has been completed since that time for Henrico County.

According to the Flood Insurance Study, the Upham Brook watershed saw flooding from intense rainfall because the channel was unable to adequately manage the flow. Channel improvements were made that seem to have improved the situation. As of the Flood Insurance Study, a flood problem still existed in the Bloomingdale area.

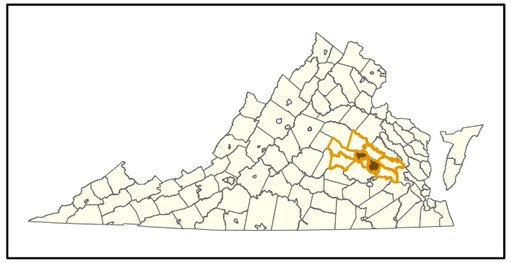
Along the James River, the Base Flood Elevation (BFE) ranges from 121.6 feet in the western portion of the county to 145.2 feet in the eastern portions of the county. BFEs on Gillies Creek range from 47.6 feet to 109.4 feet. On Stony Run, the BFEs range from 78.7 to 110.1 feet while along the Upham Brook the BFEs range from 101.6 to 197.7 feet.[24]

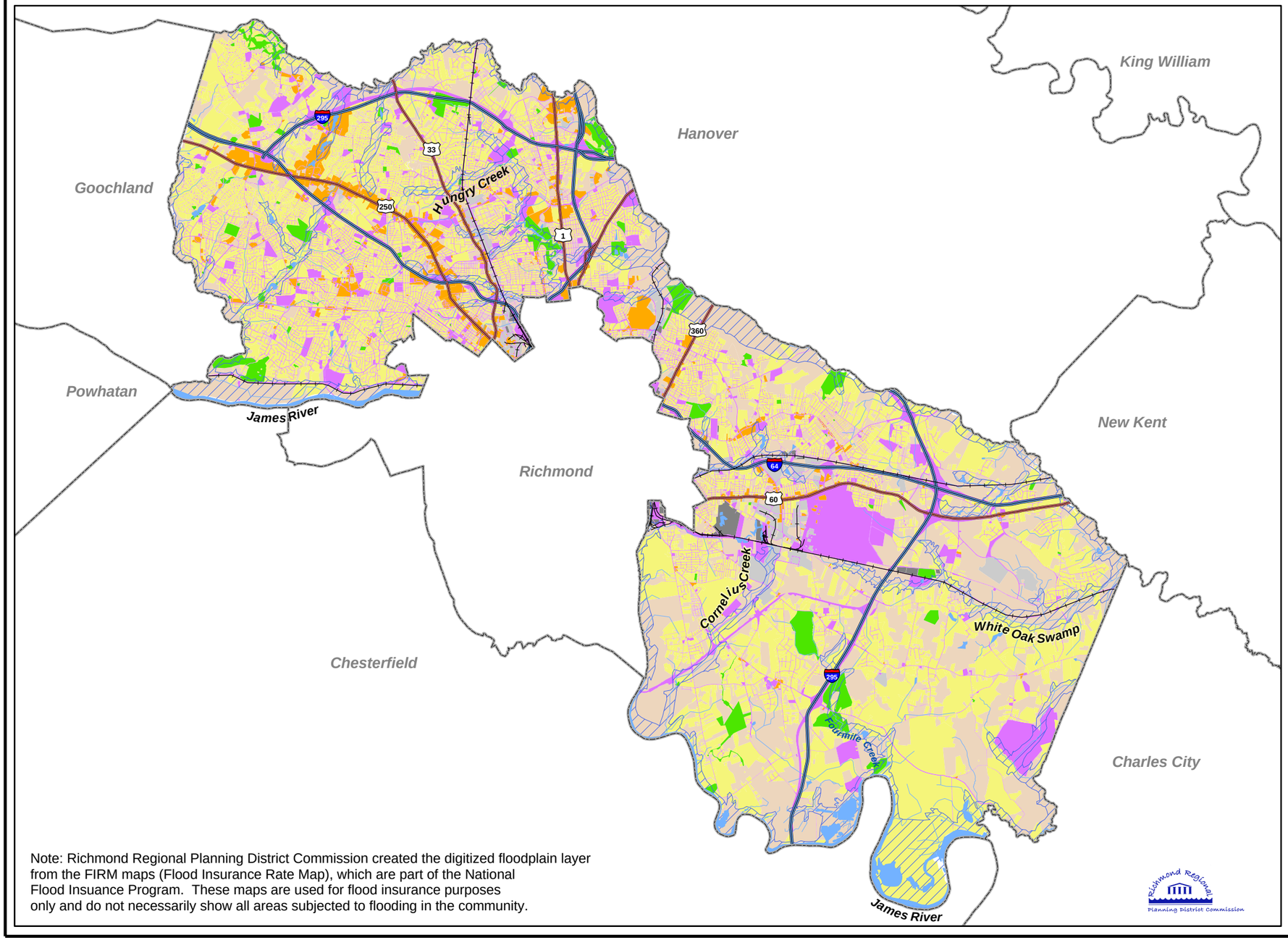
Q3 flood data is not available for Henrico County. However, the FIRM was digitized for use in this analysis. The 100-year floodplain and existing land uses are shown in Figure V-10 while the floodplain and future land uses is shown in Figure V-11. Figure V-10 illustrates that the majority of the floodplain in Henrico County is used for residential or rural purposes. The Future Land Use Map, in Figure V-11, shows that much of the floodplain is intended for agricultural or open space or recreational uses in the future, transitioning away from residential uses in some parts of the county.

[24] FEMA. *Flood Insurance Study. Henrico County, VA, Unincorporated Areas.* August 4, 1980.

Potential Flooding Impact on Existing Land Use Features

Henrico County





Commercial / Business
Industrial (Heavy)
Industrial (Light)
Open Space / Recreation
Public / Semi-Public
Residential (various)
Rural Land
Interstate
US Highway
Railroad
Stream
Intermittent Stream
Waterbody
Floodplain (100-year)

N

0 1.25 2.5 5 7.5 Miles

Source: US Census Bureau, 2000
Henrico County, 2004
National Flood Insurance Rate Map, September 15, 1981
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

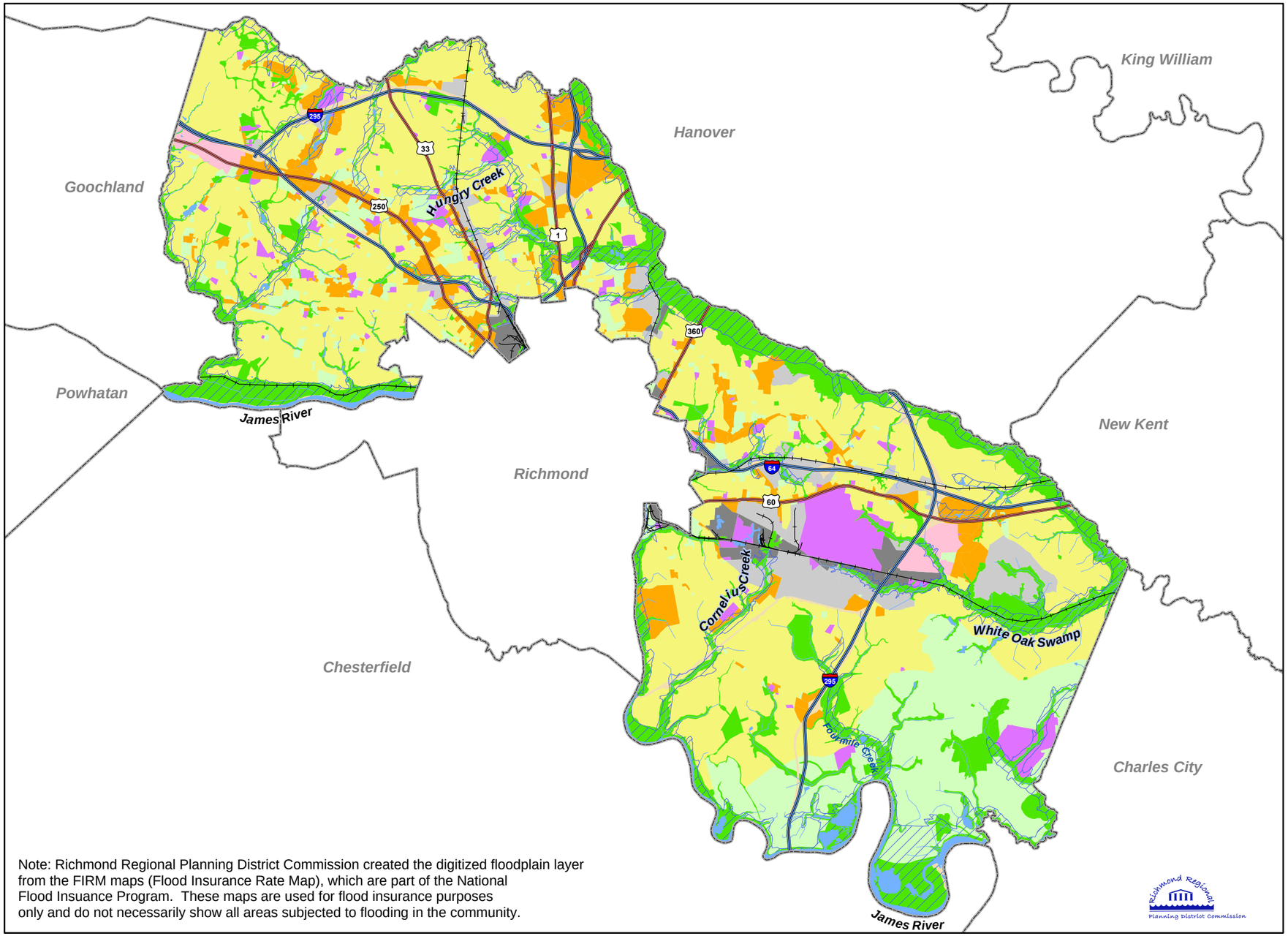
Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Richmond Regional Planning District Commission

V-10 - Henrico County Floodplain and Existing Land Use

Potential Flooding Impact on Future Land Use Features

Henrico County



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

- Agricultural
- Business / Commercial
- Industry (Light)
- Industry (Heavy)
- Mixed Use
- Open Space / Recreation
- Public / Semi-Public
- Residential (various)
- Rural Land
- Interstate
- US Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

N

0 1.25 2.5 5 7.5 Miles

Source: US Census Bureau, 2000
Henrico County, 2004
National Flood Insurance Rate Map, September 15, 1981
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

V-11 - Henrico County Floodplain and Future Land Use

In general, flooding is a nuisance in Henrico County but does not cause major damage. The Upham Brook channel and its tributaries caused flooding problems during Tropical Storm Gaston in August of 2004. Improvements to the channel were made in the 1980s and 1990s but flooding persists in this area. Road and culvert improvements in the Wilkerson area also were made some time ago. In addition, concrete and riprap was installed in Upham Brook at Route 1 as part of a state project. The Bloomingdale area, south of Route 1 at the county line, was flooded during Tropical Storm Gaston by tributaries of Upham Brook, in particular the creek from Staples Mill Pond. Homes east of Route 1 also have been flooded by Upham Brook. This area is highlighted on Figure V-21 as Area #1.

Hillard Road and Route 1 in the Lakeside area experiences flooding from Rocky Branch. In addition, localized flooding occurs in the Creighton Road and Chickahominy Road area, as well as, in the Woodman and Mountain road area. A relatively new subdivision is located here but none of the homes are in the floodplain as the subdivision was designed with that in mind.

Tropical Storm Gaston also cause the bridge over Hungary Creek to be scoured out (Area #2 on V-21) and flooded the Lakeside substation.

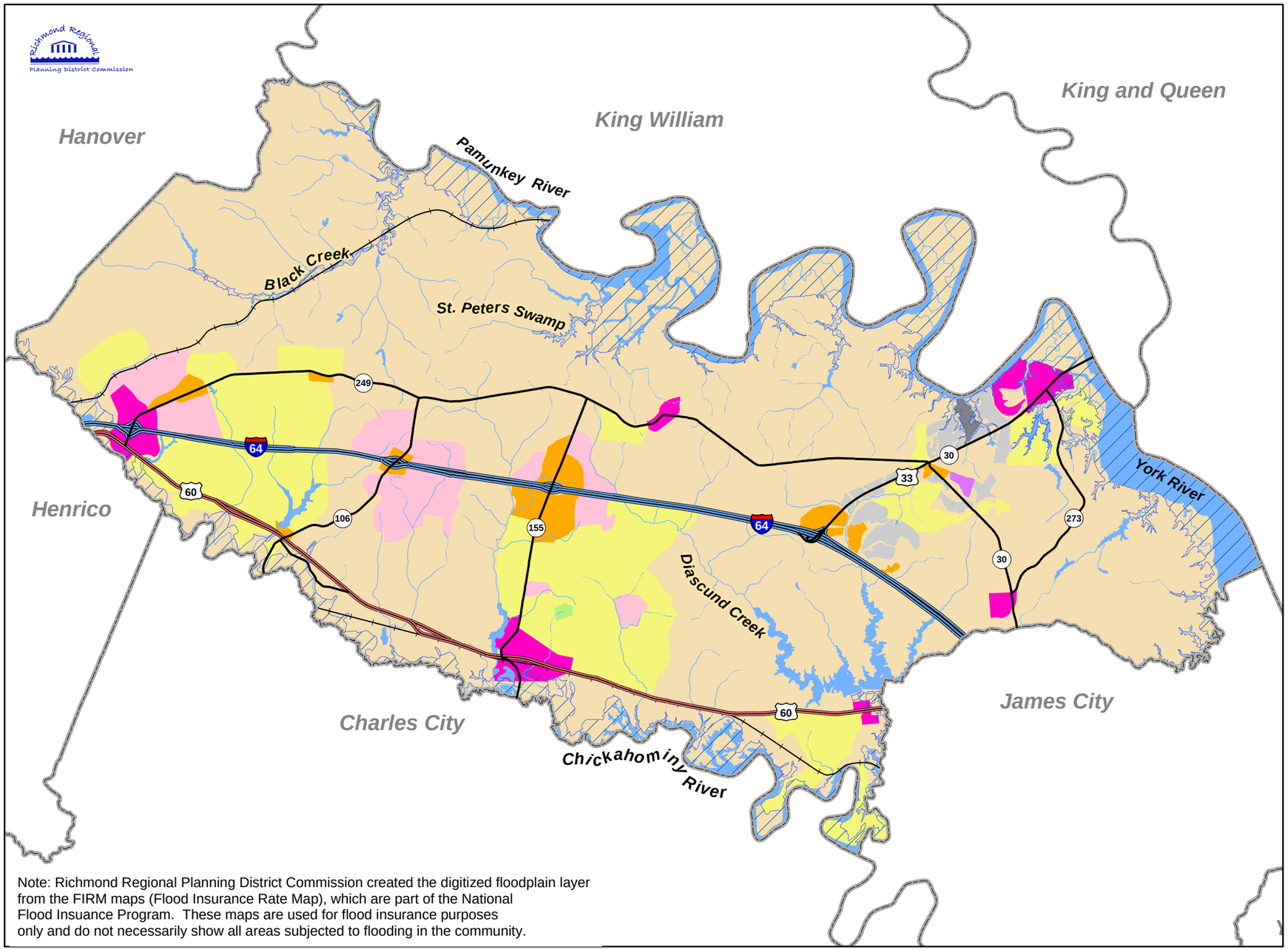
New Kent County

Tidal flooding from the York, Pamunkey and Chickahominy River is the main issue in New Kent County. The upper reaches of these rivers also may experience fluvial flooding. Other water bodies in New Kent County include Baker, Beaverdam, and Black Creeks, Crumps Swamp, Toe Ink Swamp, St. Peters Swamp, Davis Pond, and Diascund Creek and Reservoir.

The Flood Insurance Study only examined tidal flooding. The 100-year stillwater elevations for the York and Pamunkey Rivers and their estuaries are 8.0 feet while the Chickahominy River has a stillwater elevation of 8.5 feet. No portion of the shoreline is at risk to significant wave attack.

Q3 flood data is not available for New Kent County. However, the FIRM was digitized for use in this analysis. The 100-year floodplain and existing land uses are shown in Figure V-12 while the floodplain and future land uses is shown in Figure V-13.

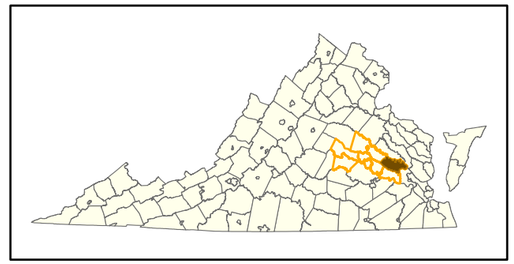
As seen in Figure V-12, much of the floodplain currently is classified as rural land. On the Future Land Use Map, this land typically remains classified as rural or conservation land or has been reclassified for agricultural or forest use.



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Potential Flooding Impact on Existing Land Use Features

New Kent County



- Business / Commercial
- Industrial (Light)
- Industrial (Heavy)
- Institutional
- Mixed Use
- Open Space / Recreation
- Residential (various)
- Village
- Rural Land
- Interstate
- US Primary Highway
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

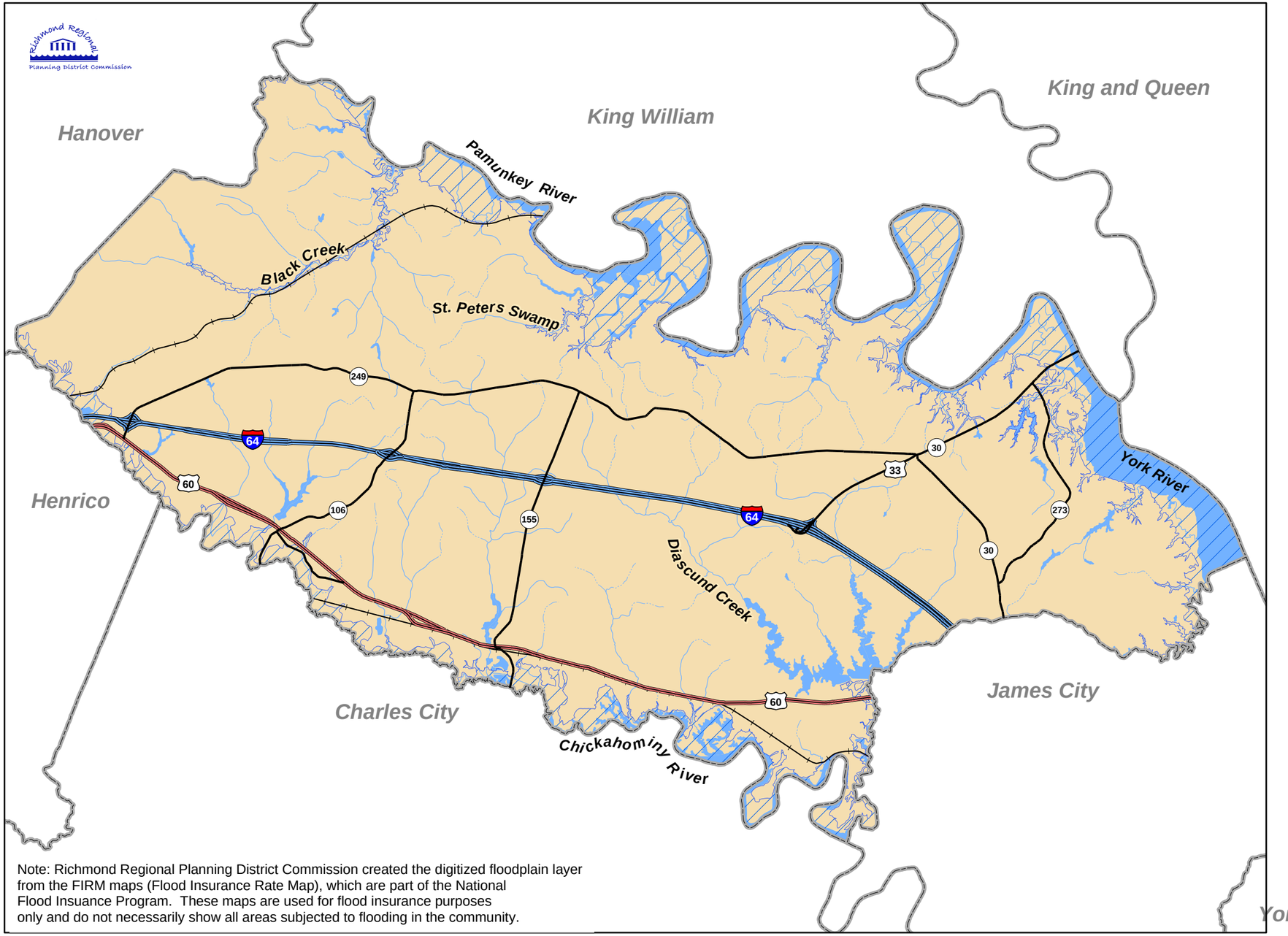
N

0 1.25 2.5 5 7.5 Miles

Source: US Census Bureau, 2000
New Kent County, 2004
National Flood Insurance Rate Map, March 1990
Richmond Regional Planning District Commission, 2004

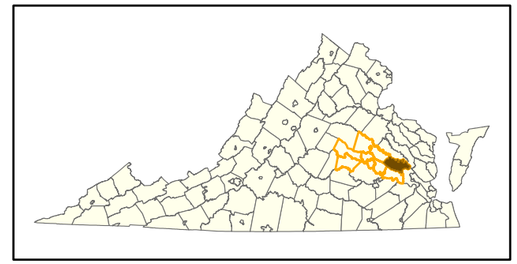
Created by: Richmond Regional PDC, November 2005

V-12 - New Kent County Floodplain and Existing Land Use



Potential Flooding Impact on Future Land Use Features

New Kent County



- Agricultural / Forest
- Business / Commercial
- Economic Opportunity
- Hamlet / Village
- Industrial (light)
- Residential (various)
- Rural Land
- Rural Land
- Interstate
- US Primary Highway
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

N

0 1.25 2.5 5 7.5 Miles

Source: US Census Bureau, 2000
New Kent County, 2004
National Flood Insurance Rate Map, March 1990
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

V-13 - New Kent County Floodplain and Future Land Use

Fannies Creek at State Route 627 poses a threat to public safety. The road is the only ingress/egress for the Chickahominy Shores and Turner's Neck subdivisions and the Colonial Harbor Marina and Campground. The road floods after any significant rainfall event and also may flood if there is an abnormal high tide. Residents of approximately 120 homes are potentially affected. This area is highlighted on Figure V-22 as Area #1.

Walkers Dam across the Chickahominy River in the south-central part of the county may pose a threat to homes. The dam is used to create a water impoundment site to supply drinking water for the City of Newport News. According to local officials, the dam is either incapable of being used as a device to lower water level in the upstream Chickahominy Lake or is not used for this purpose for flood control. Rockahock Campground and Rockahock Mobile Home Park are adjacent to the dam and may be at risk. This area is highlighted on Figure V-22 as Area #2.

State Road 638 also floods frequently in the Bottom's Bridge area, at Black Creek Crossing. VDOT often responds to this area and places warning and water level signs there. In addition, Henpeck Road frequently floods between State Road 60 and Interstate 64. This area is highlighted on Figure V-22 as Area #3. Farmer's Drive, State Road 273, can flood near Plum Point during exceptionally high tidal surge. This area historically drains quickly.

Local officials also report that there are no NOAA/NWS stream gauges on the Chickahominy River. There may be one or two gauges monitored by state agencies but this information is typically not relayed to the NWS, therefore, there is no flooding or crest modeling information provided. This lack of information hinders response actions by the county.

Powhatan County

Of concern for Powhatan County is flooding from the James and Appomattox Rivers. Bernards, Branch, Butterwood, Deep, Fighting, Fine, Jones, Norwood, and Sallee Creeks also pose a potential flood threat. Rocky Ford Road occasionally is flooded by the nearby creek but this road has a relatively low number of users. There are few other roads in the county that experience periodic flooding.

Powhatan County has enacted floodplain regulations that prohibited development in the floodplain before development began in earnest in the county. Because of the foresight of the county, the only structures in the floodplain are outhouses and barns with little to no value.

Water bodies account for approximately four of Powhatan's 269 square miles. Powhatan is characterized by a gently rolling topography. The flood plains for the James River range from 200 to 5,400 feet in the county. Low-lying areas adjacent to the James River are subject to periodic flooding.

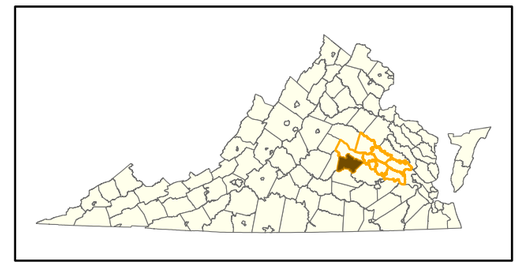
Along the James River, the Base Flood Elevation (BFE) ranges from 146.5 feet in the western portion of the county to 199.4 feet in the eastern portions of the county. The BFEs range from 202.9 feet to 243.2 feet on Fighting Creek.[25]

Q3 flood data is not available for Powhatan County. However, the FIRM was digitized for use in this analysis. The 100-year floodplain and existing land uses can be seen in Figure V-14. The overwhelming majority of land within the floodplain is used for rural purposes. Figure V-15 shows the 100-year floodplain and future land uses. The majority of the floodplain remains intended for rural uses though some of it is planned for public or institutional uses. It should be noted, however, that Powhatan County prohibits any structures within the floodplain, regardless of overall land use of the parcel.

[25] FEMA. *Flood Insurance Study. Powhatan County, VA, Unincorporated Areas.* March 1978.

Potential Flooding Impact on Existing Land Use Features

Powhatan County



- Business Service Area
- Business Service Sub-Area
- Rural Preservation Sub-Area
- Village Preservation Area
- Village Service Area
- US Primary Highway
- State Primary Highway
- Rural Land
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

N

0 1.25 2.5 5 7.5 Miles

Source: US Census Bureau, 2000
Powhatan County, 2004
National Flood Insurance Rate Map, September 15, 1978
Richmond Regional Planning District Commission, 2004

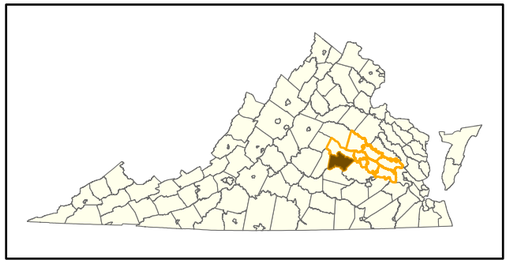
Created by: Richmond Regional PDC, November 2005

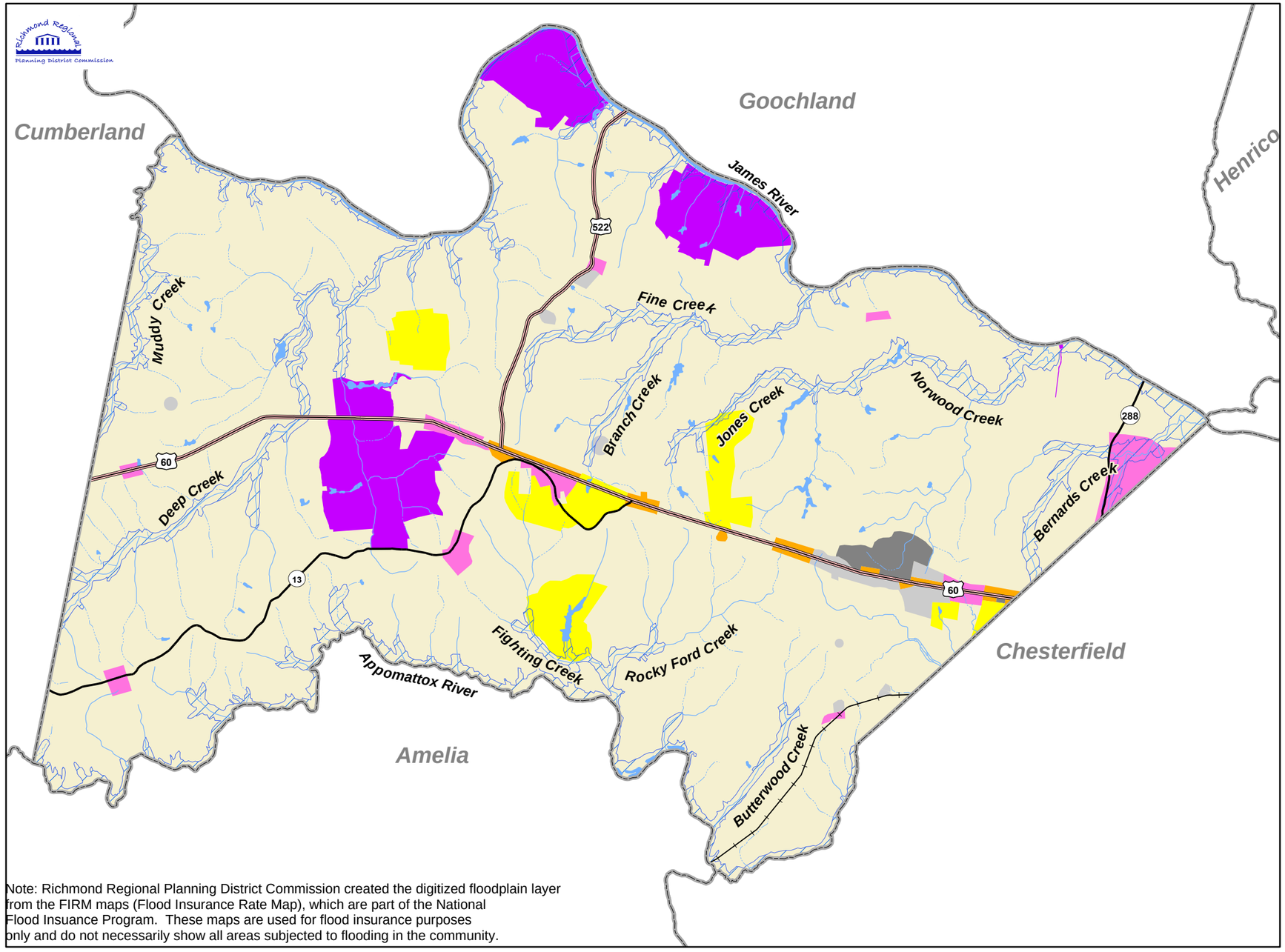
Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

V-14 - Powhatan County Floodplain and Existing Land Use

Potential Flooding Impact on Future Land Use Features

Powhatan County





Ecomonical Development
Industry (Heavy)
Industry (Light)
Mixed Use (Village)
Public / Institutional
Residential
US Primary Highway
State Primary Highway
Rural Land
Railroad
Stream
Intermittent Stream
Waterbody
Floodplain (100-year)

N

0 1.25 2.5 5 7.5 Miles

Source: US Census Bureau, 2000
Powhatan County, 2004
National Flood Insurance Rate Map, September 15, 1978
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

V-15 - Powhatan County Floodplain and Future Land Use

City of Richmond

The James River is the main source of flooding in the City of Richmond. Other urban and suburban streams that run through the city include Pocosham, Grindall, Broad Rock, Goodes, Powhite, Rattlesnake, Stony Point, Pittaway, and Gillies Creeks and Stony Run.

Most flooding occurs below the falls of the James River where the water is sluggish, tidal and development is more intense. According to the 1998 Flood Insurance Study, a great deal of Richmond's industrial and commercial section is subject to flooding when the James River reaches flood stages equal to or greater than the 20-year event.

Navigation on the James River to the Port of Richmond is not possible if the river is at a flood stage of 14 feet or more. These conditions do not generally last more than a few days.

The Shockoe Creek levee provides protection for small floods but has been ineffective during major flooding. The floodwall constructed along the James River is designed to provide protection against the 100-year flood but it does not provide adequate protection beyond that. In addition, there have been several channel improvement and dam projects by the Army Corps of Engineers that have reduced flood elevations along the James River.

The regulatory Base Flood Elevation (BFE) along the James River range from 26.8 feet to 135 feet. Along Pocosham Creek, the regulatory BFEs range from 134.3 to 200.9 feet. On Powhite Creek, the regulatory BFEs range from 91.9 to 139.8 feet.[26]

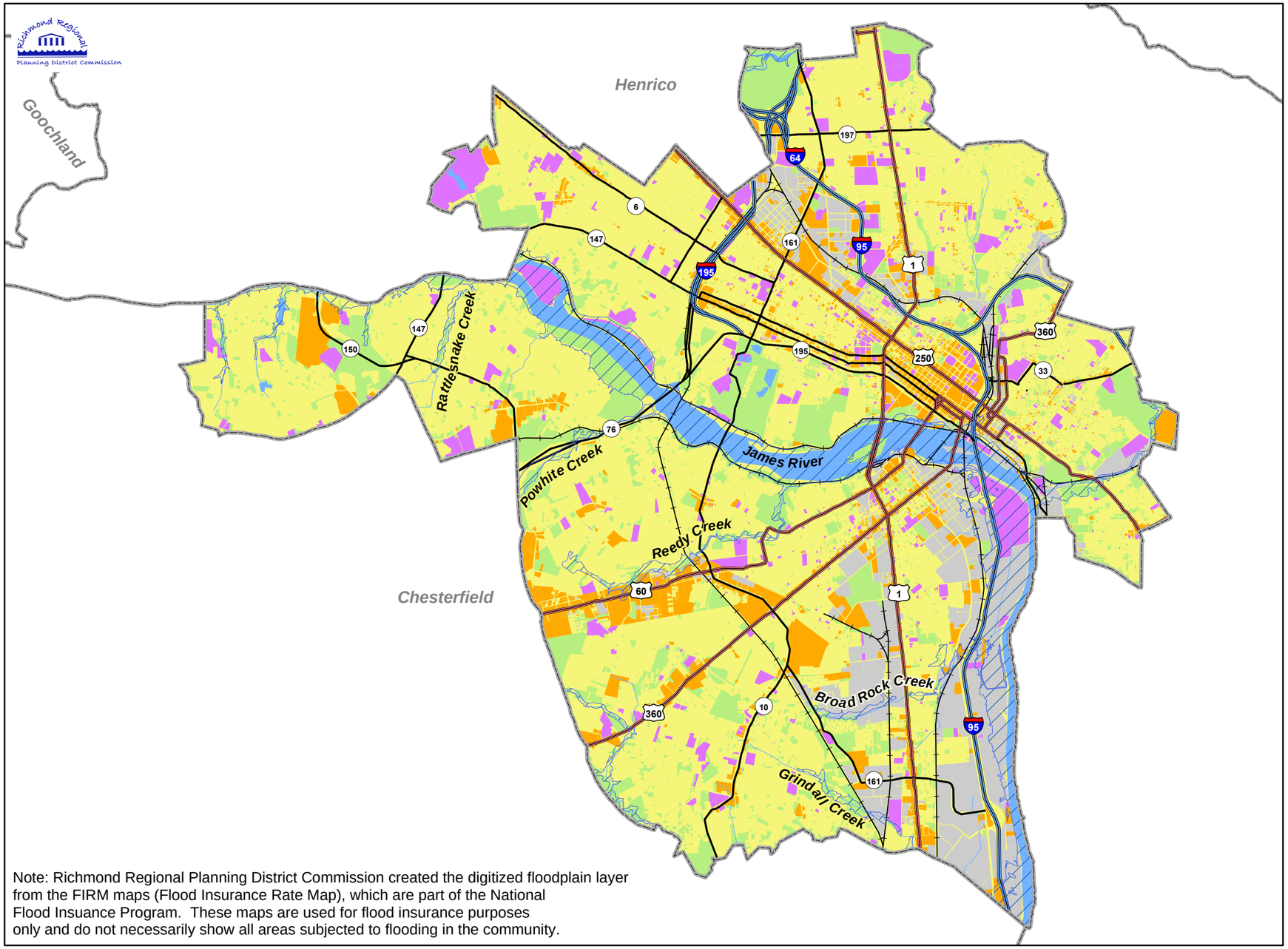
Q3 flood data is not available for the City of Richmond. However, the FIRM was digitized for use in this analysis and is shown in Figure V-16 and V-17. As seen in Figure V-16, much of the floodplain is currently designated as industrial use. In the future, much of this land is intended for open space or economic opportunity use as seen in Figure V-17.

The City of Richmond is largely developed so the dominant development trend is redevelopment. Older, lower value structures are being renovated or replaced by newer construction with significantly higher dollar values. Part of this revitalization is occurring along the James River in the Shockoe Bottom area, which is protected by a floodwall. This area was flooded, however, in 2004 by Tropical Storm Gaston, which was reported to be a 500-year event. The flooding was mainly due to the inability of the stormwater system to handle an intense amount of rainfall over a short period of time. New development in this area, though, is at risk for future flooding from similar events.

[26] *Flood Insurance Study. City of Richmond, VA.*

The James River, as it flows through the City of Richmond presents a challenge in terms of flood prediction. There are four conditions under which flooding can occur along the James in the City of Richmond:

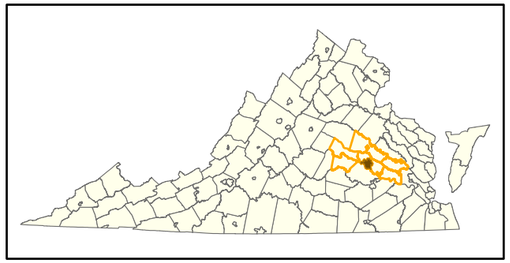
1) River is free-flowing and tidally influenced (below the Falls Line) by high tide
2) River is free-flowing but not tidally influenced (above the Falls Line)
3) floodwall open; and
4) floodwall closed.



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Potential Flooding Impact on Existing Land Use Features

Richmond City



- Commercial / Office
- Industrial
- Open Space / Recreation
- Public / Institutional
- Residential
- Interstate
- US Primary Highway
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

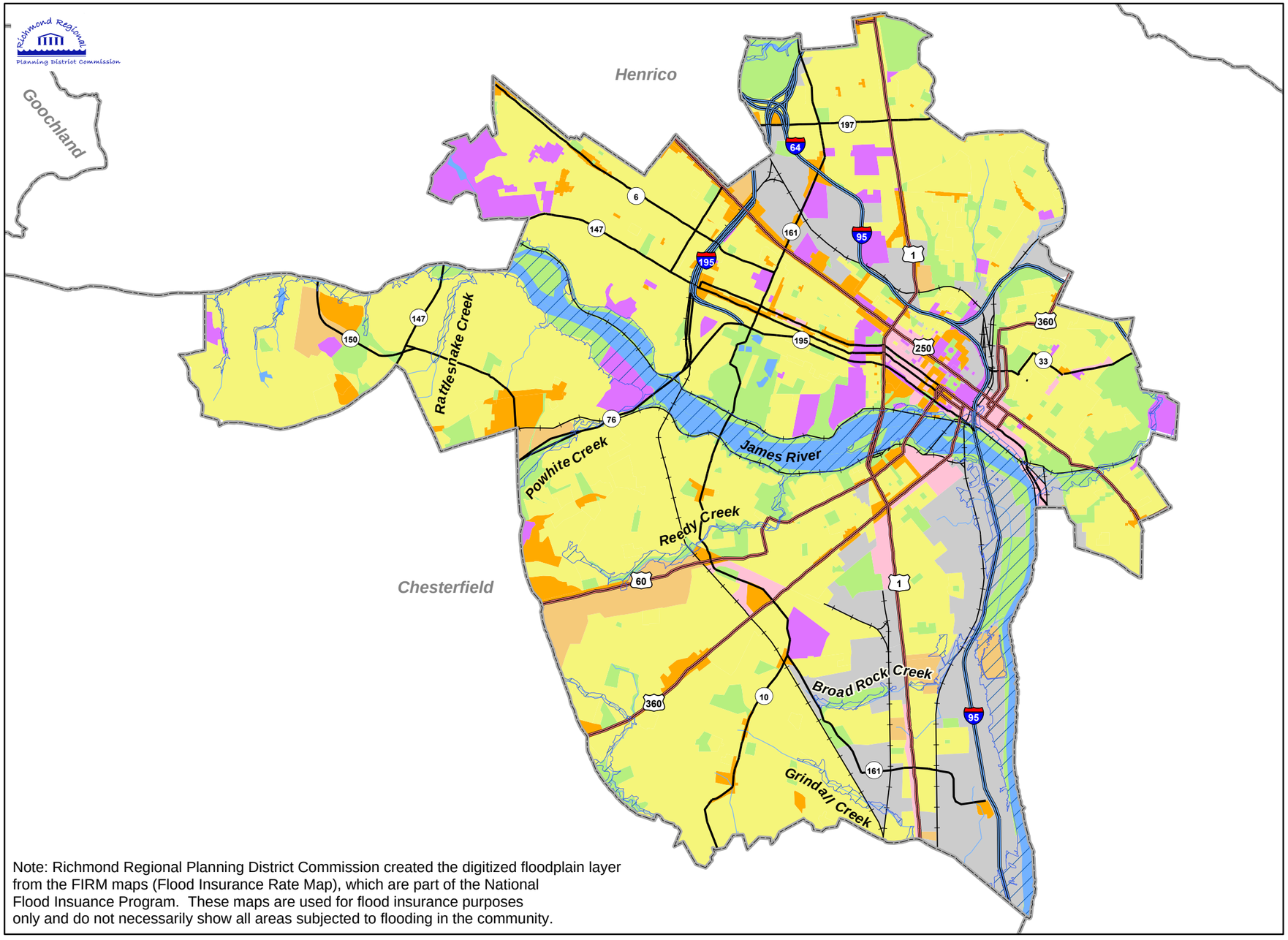
N

0 0.5 1 2 3 Miles

Source: US Census Bureau, 2000
Richmond City, 2004
National Flood Insurance Rate Map, September 15, 1979
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

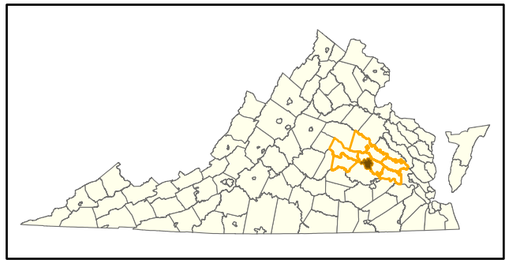
V-16 - City of Richmond Floodplain and Existing Land Use



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Potential Flooding Impact on Future Land Use Features

Richmond City



- Business / Commercial
- Economic Opportunity
- Industrial
- Mixed Use
- Public / Institutional
- Open Space / Recreation
- Residential
- Interstate
- US Primary Highway
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

N

0 0.5 1 2 3 Miles

Source: US Census Bureau, 2000
Richmond City, 2004
National Flood Insurance Rate Map, September 15, 1979
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

Figure V-17. City of Richmond Floodplain and Future Land Use

Structures at Risk

In order to assess the study area's potential vulnerability to flooding, specific data regarding structures located in the floodplain was collected as a part of this analysis. Structures potentially in the floodplain were identified by comparing the floodplain areas from the FEMA FIRMs with each county's and the city's existing parcel and building data, gathered primarily from tax assessment records.

The amount of information available varied from jurisdiction to jurisdiction but generally included the parcel use or structure occupancy type, building or improvement value, and total assessed value. More specific information, such as type of construction, number of stories, number of rooms, and square footage was available for some but not all jurisdictions.

Additional data varies from locality to locality but, in general, the location of existing hospitals, police stations, schools, fire stations, and government buildings are known. Therefore using the digital flood data described above, a count of the number of structures located within the floodplain was generated and total value at risk approximated. The accuracy and completeness of this structure count is limited by the accuracy and completeness of the digital data.

From the data collected, a total of 4,439 parcels are located completely in the floodplain, with an estimated total value of over $735 million dollars. Additionally, a total of 8,953 parcels are partially located in the floodplain, with an estimated total value of over $3.2 billion dollars. It is unknown if structures located on these parcels are within the floodplain as digital building footprint data were not available.

Tables V-5 includes a summary by jurisdiction the number, approximate value, and predominant use of the parcels fully located in the 100-year floodplain that had improvements or buildings. Table V-5a summarizes by jurisdiction the number, approximate value, predominant use and potential exposure of the parcels partially located in the 100-year floodplain that had improvements or buildings. To determine potential exposure, a percentage of the total value of the parcels was calculated based on building type and the nature of development patterns in the jurisdiction. Since the exact location of the buildings is unknown, the exposure figures are an approximation and may be greater or less than stated. Appendix F provides more detail on the analysis completed for each jurisdiction.

As can be seen in Table V-5 and Table V-5a, residential uses tend to dominate within the floodplain. Of note, Henrico County has a great deal of high-value commercial and industrial development on parcels that are partially within the floodplain. Since the exact location of the buildings is unknown, the true risk to these facilities is unknown and the exposure figures could be skewed to a higher number. Also, as noted previously, the only

structures in the floodplain in Powhatan County are outhouses and barns with little to no value.

Table V-5 – Parcels Fully in the Floodplain by Jurisdiction

Number of Parcels with Improvements/Buildings	Predominant Use/Zoning	Total Value of Improvements/Buildings
Charles City County		
14	Dwelling	$983,800
Goochland County		
0	N/A	N/A
Hanover County		
51	Agricultural	$9,809,300
Town of Ashland		
0	N/A	N/A
Henrico County		
4,167	Residential	$677,062,900
New Kent County[27]		
74	Rural	$7,342,000
Powhatan County*		
0	N/A	N/A
City of Richmond		
147	Residential	$40,799,500

Source: GIS analysis by RRPDC

** No structures with significant value are within the floodplain.*

[27] Only total assessed value available. Use or zoning type unavailable. Type of owner identified using owner name from available data.

Table V-5a – Parcels Partially in the Floodplain by Jurisdiction			
Number of Parcels with Improvements/Buildings	Predominant Use/Zoning	Total Value of Improvements/Buildings	Potential Exposure
Charles City County			
240	Dwelling	$31,375,800	$6,275,160
Goochland County			
743	Agricultural	$391,814,000	$67,859,340
Hanover County			
2,832	Agricultural	$868,697,700	$148,903,675
Town of Ashland			
18	Agricultural	$6,875,500	$1,168,835
Henrico County			
3,515	Residential	$1,766,617,000	$529,985,100
New Kent County			
809	Rural	$191,418,900	$37,612,380
Powhatan County*			
0	N/A	N/A	N/A
City of Richmond			
796	Residential	$526,226,700	$210,490,680

Source: GIS analysis by RRPDC

** No structures with significant value are within the floodplain.*

Critical Facilities

The impacts of floodwaters on critical facilities, such as police and fire stations, hospitals, and schools, can greatly increase the overall effect of a flood event on a community.

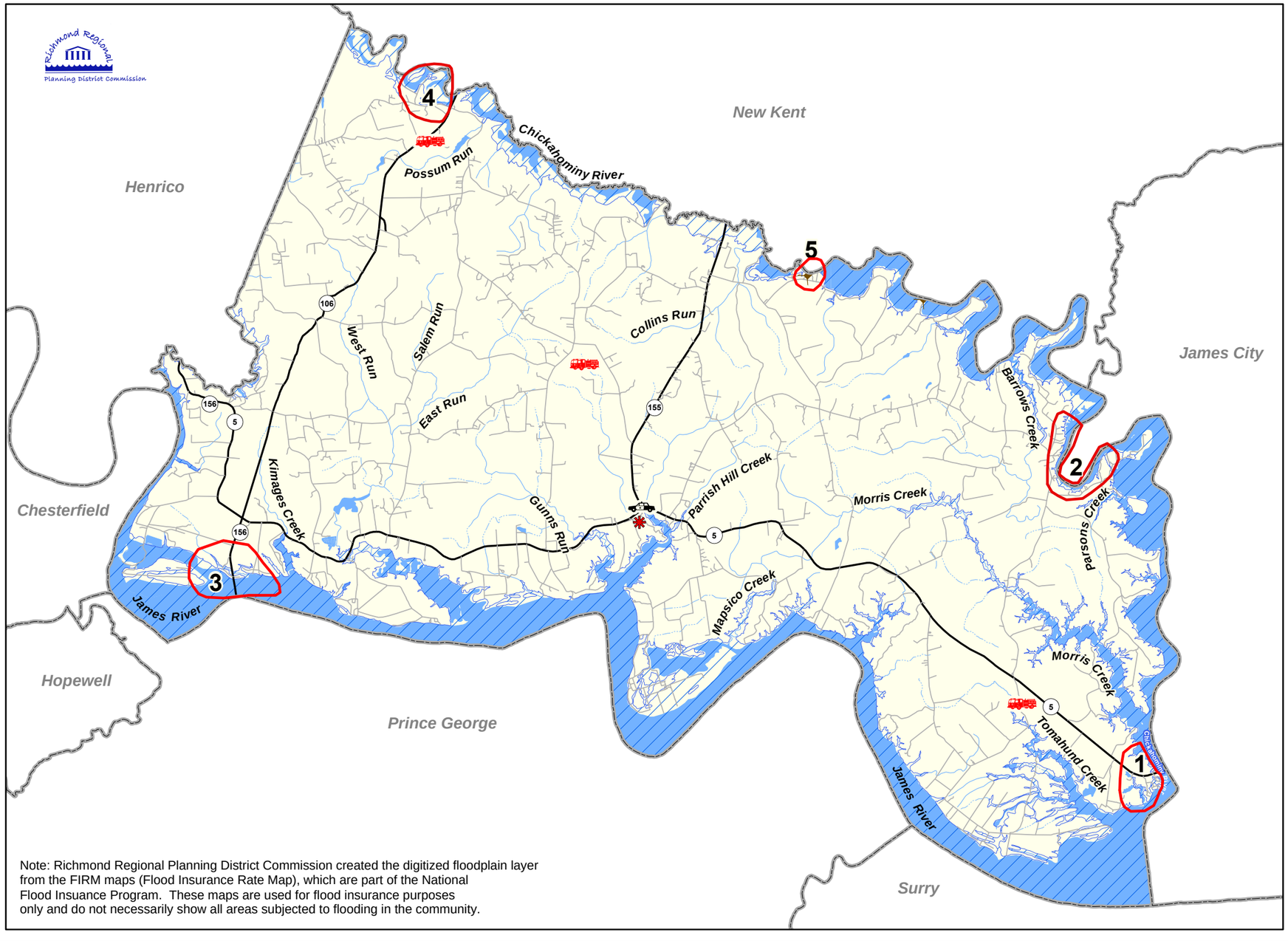
The HAZUS data was used as a starting point to identify critical facilities in the study area. This data was verified and updated by the Richmond Regional Planning District. Using this data and the digitized flood maps, a count of these facilities located in the floodplain was generated, and is included in Table V-6. Figures V-16 through V-21 show the critical

facilities and their relationship to the floodplain. In addition, local problem spots described in the previous jurisdiction-specific sections are identified.

Table V-6 — Known Critical Facilities in the Floodplain		
Jurisdiction	**Type**	**Count**
Charles City County	None	0
Goochland County	School	1
Hanover County	Superfund site	4
Town of Ashland	None	0
Henrico County	Superfund site	24
	School	3
	Fire station	1
New Kent County	Superfund site	1
Powhatan County	None	0
City of Richmond	Superfund site	9
Source: GIS analysis by RRPDC		

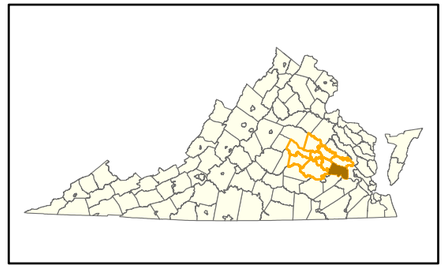
It should be noted that these facilities have been determined to be in the floodplain using a planning level analysis, and should be used only as a planning tool. In order to accurately determine if a structure is actually located in the floodplain, site-specific information must be available. In addition, this data set is limited by the GIS data available.

There are only a limited number of critical facilities located in the floodplain. Most of the sites identified are Superfund sites. The environmental implications of these highly polluted sites should be considered in the planning process.



Critical Facilities and Areas of Concern Within the Floodplain

Charles City



Area of Concern
Dams
EOC
Police Station
Fire Stations
State Primary Highway
Secondary Highway
Stream
Intermittent Stream
Waterbody
Floodplain (100-year)

N

0 1 2 4 6 Miles

Source: US Census Bureau, 2000
National Flood Insurance Rate Map, September 5, 1990
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

Figure V-18 - Charles City County Critical Facilities and Areas of Local Concern

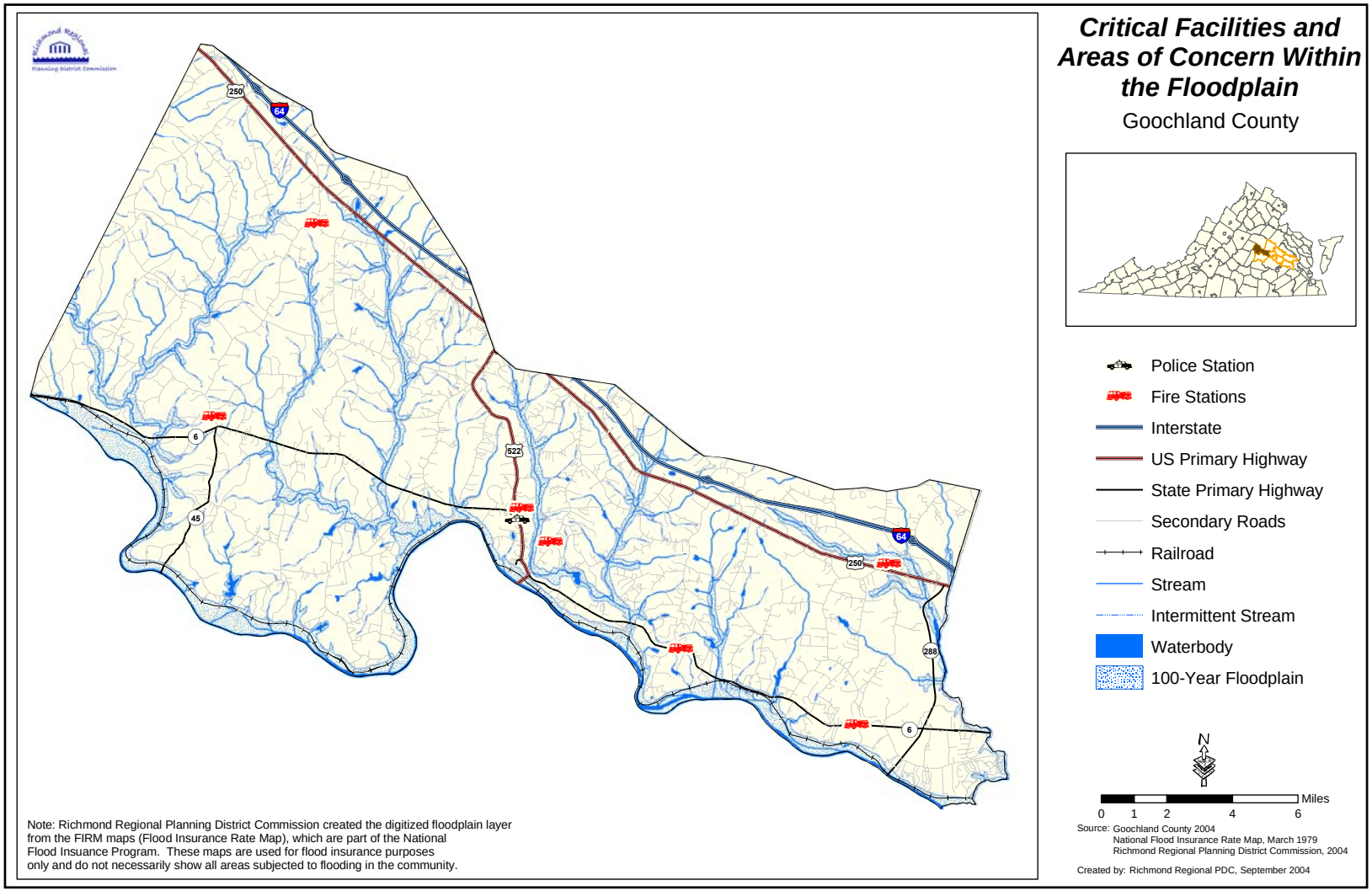
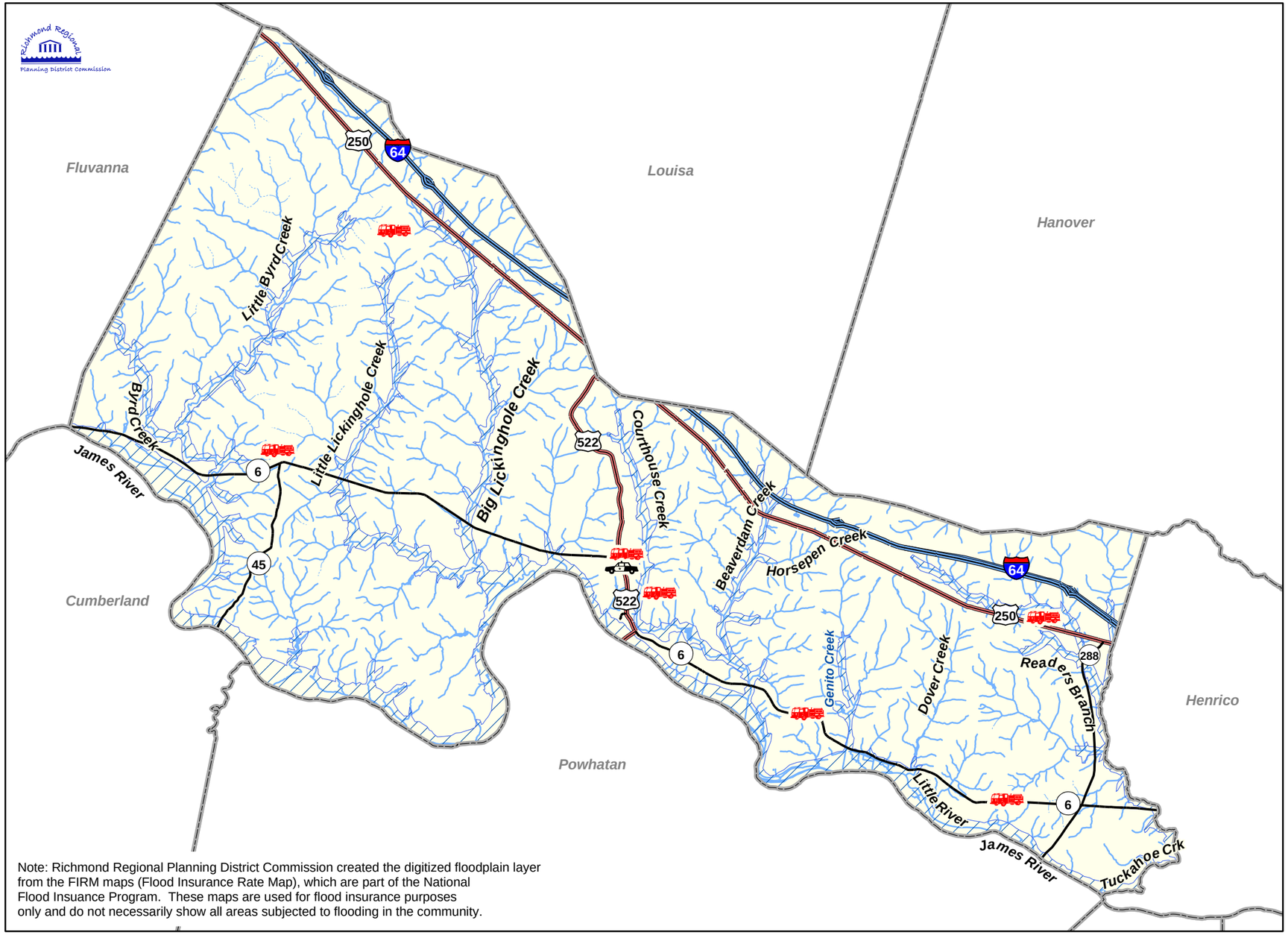


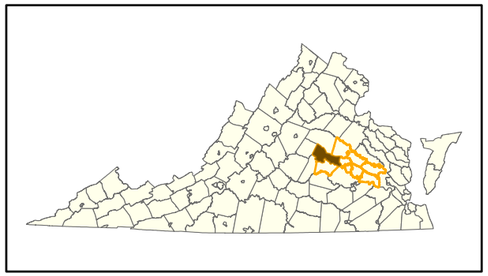
Figure V-19 – Goochland County Critical Facilities



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Critical Facilities and Areas of Concern Within the Floodplain

Goochland County



- Police Station
- Fire Stations
- Interstate
- US Primary Highway
- State Primary Highway
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

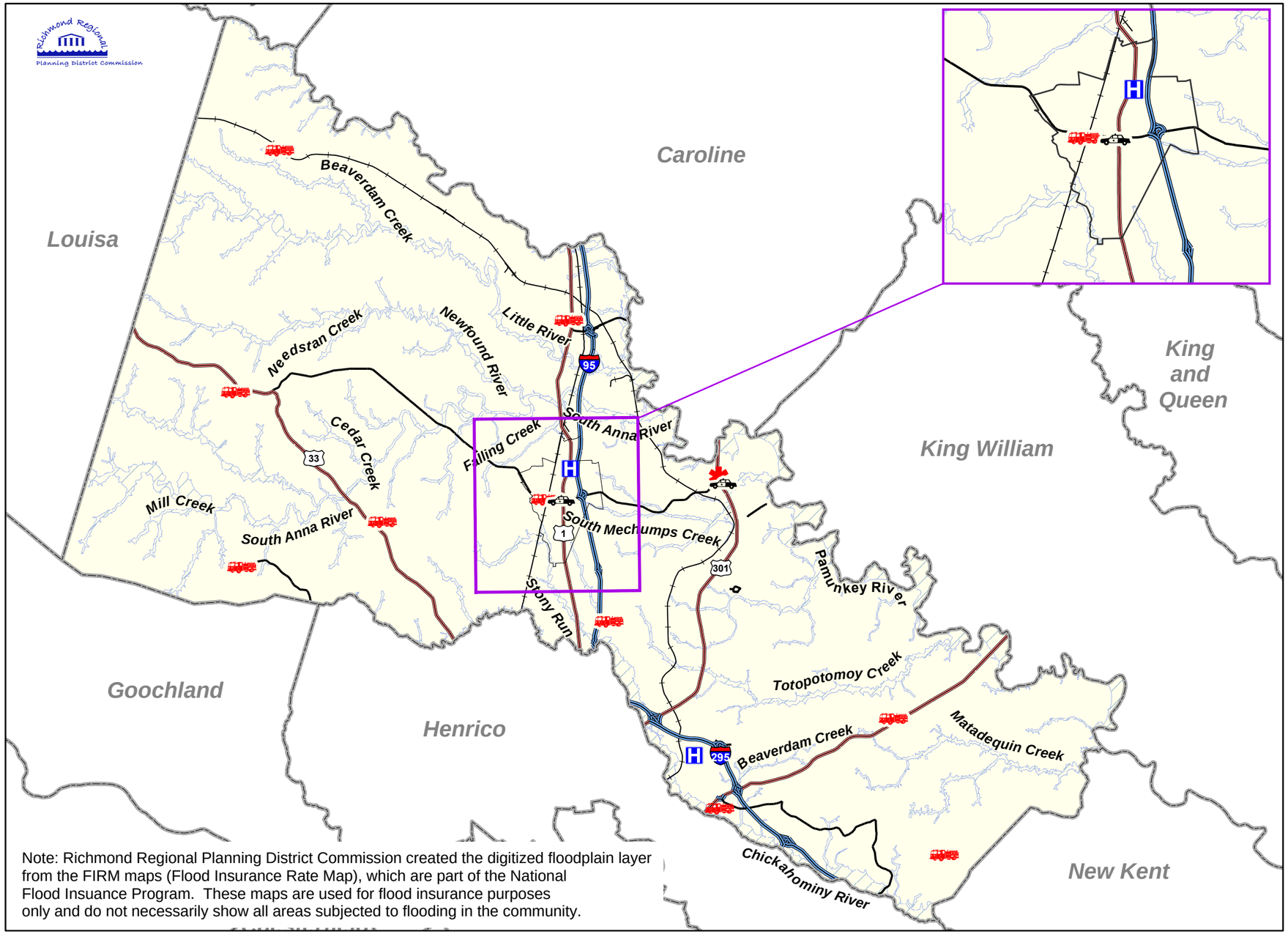
N

0 1 2 4 6 Miles

Source: US Census Bureau, 2000
Charles City County, 2004
National Flood Insurance Rate Map, September 5, 1993
Richmond Regional Planning District Commission, 2004

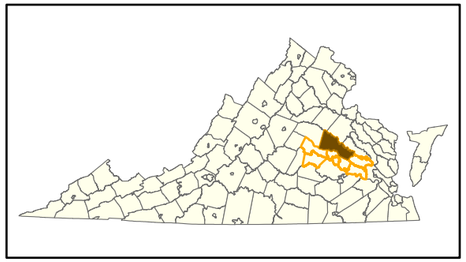
Created by: Richmond Regional PDC, November 2005

Figure V-19 - Goochland County Critical Facilities and Areas of Local Concern



Critical Facilities and Areas of Concern Within the Floodplain

Hanover County
(Includes Town of Ashland)



- EOC's
- Police
- Fire Station
- Hospital
- Interstate
- US Primary Highway
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

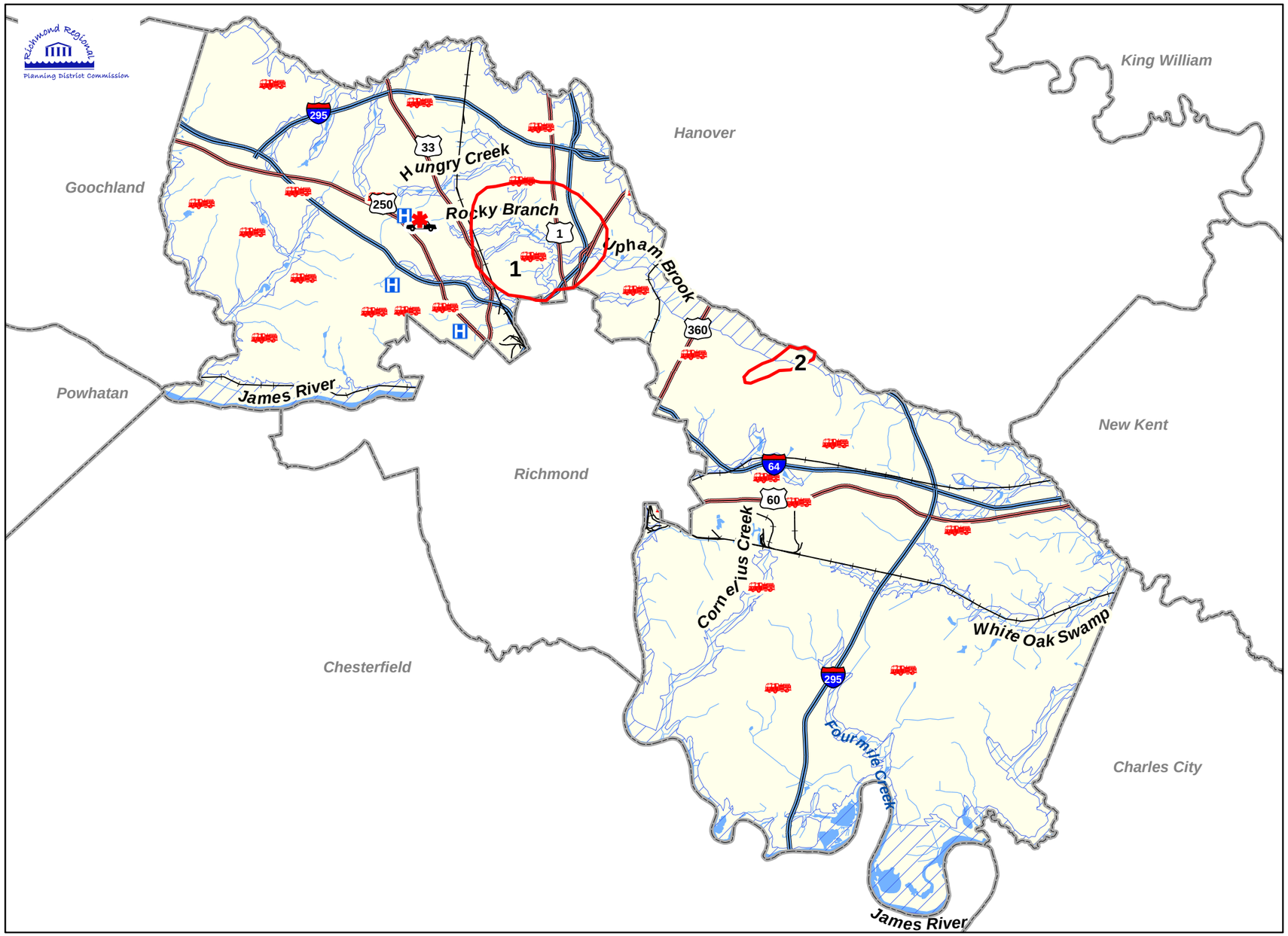
N

0 1.5 3 6 9 Miles

Source: US Census Bureau, 2000
Hanover County, 2004
National Flood Insurance Rate Map, March 1979
Richmond Regional Planning District Commission, 2004

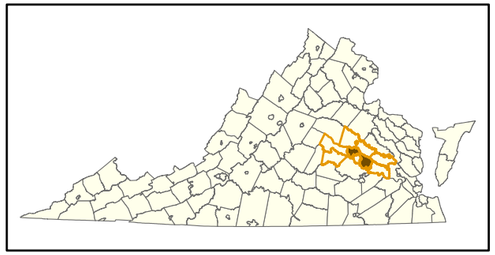
Created by: Richmond Regional PDC, November 2005

Figure V-20 - Hanover County and the Town of Ashland Critical Facilities



Critical Facilities and Areas of Concern Within the Floodplain

Henrico County



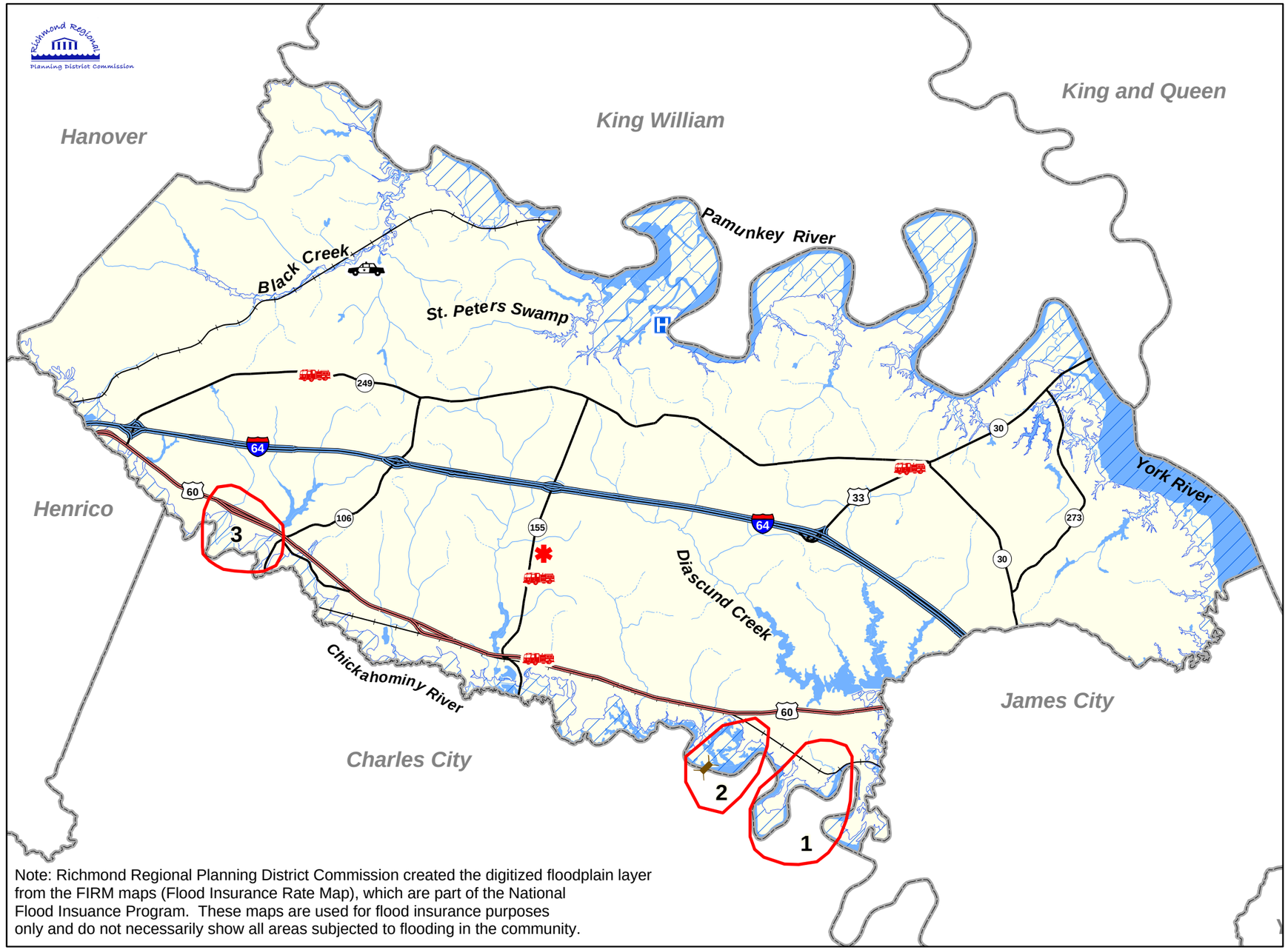
Area of Concern
EOC's
Police Station
Fire Stations
Hospitals
Interstate
US Highway
Railroad
Stream
Intermittent Stream
Waterbody
Floodplain (100-year)

N

Miles
0 1.25 2.5 5 7.5

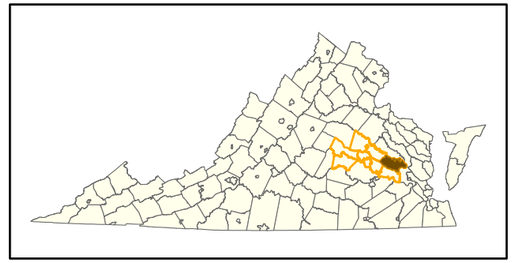
Source: US Census Bureau, 2000
Henrico County, 2004
National Flood Insurance Rate Map, September 15, 1981
Richmond Regional Planning District Commission, 2004
Created by: Richmond Regional PDC, November 2005

Figure V-21 - Henrico County Critical Facilities and Areas of Local Concern



Critical Facilities and Areas of Concern Within the Floodplain

New Kent County



Area of Concern
Dam
EOC
Police Station
Fire Stations
Hospitals
Interstate
US Primary Highway
State Primary Highway
Railroad
Stream
Intermittent Stream
Waterbody
Floodplain (100-year)

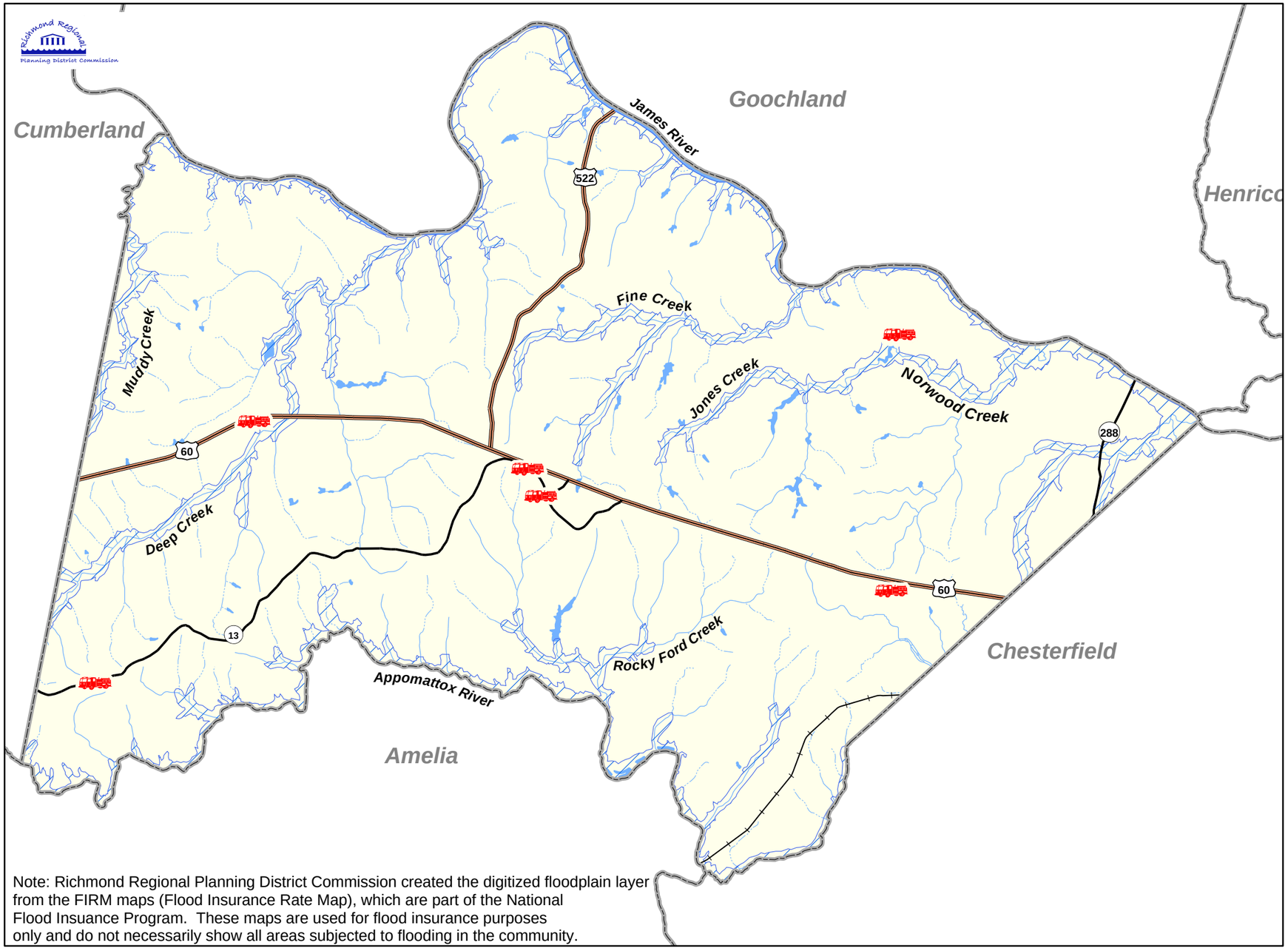
N

0 1.25 2.5 5 7.5 Miles

Source: US Census Bureau, 2000
New Kent County, 2004
National Flood Insurance Rate Map, March 1990
Richmond Regional Planning District Commission, 2004

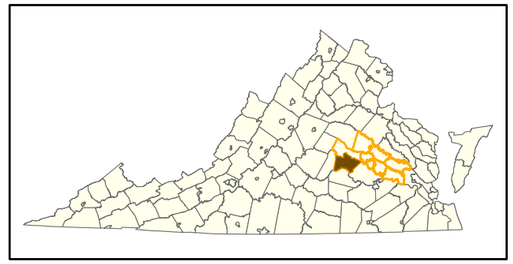
Created by: Richmond Regional PDC, November 2005

Figure V-22 - New Kent County Critical Facilities and Areas of Local Concern



Critical Facilities and Areas of Concern Within the Floodplain

Powhatan County



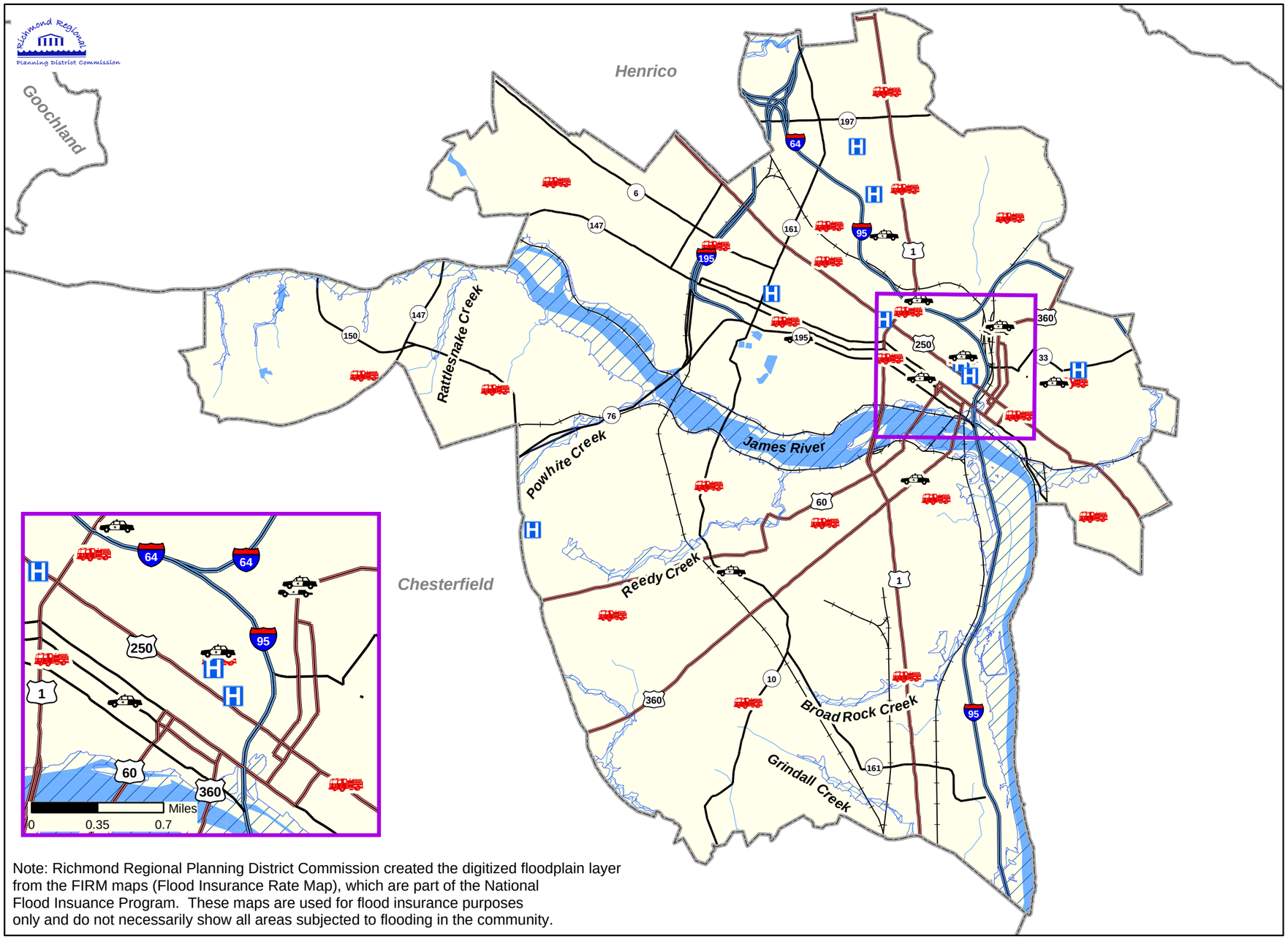
Fire Stations
Railroad
US Primary Highway
State Primary Highway
Stream
Intermittent Stream
Waterbody
Floodplain (100-year)

N

0 1.25 2.5 5 7.5 Miles

Source: US Census Bureau, 2000
Powhatan County, 2004
National Flood Insurance Rate Map, September 15, 1978
Richmond Regional Planning District Commission, 2004
Created by: Richmond Regional PDC, November 2005

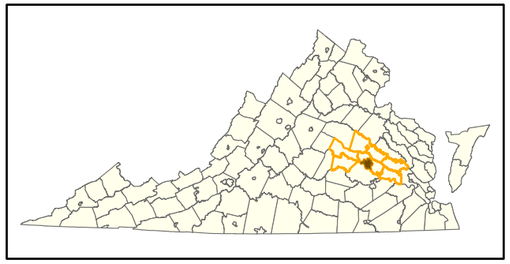
Figure V-23 - Powhatan County Critical Facilities and Areas of Concern



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Critical Facilities and Areas of Concern Within the Floodplain

Richmond City



- EOC's
- Police Station
- Fire Stations
- Hospitals
- Interstate
- US Primary Highway
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

N

Miles
0 0.5 1 2 3

Source: US Census Bureau, 2000
Richmond City, 2004
National Flood Insurance Rate Map, September 15, 1979
Richmond Regional Planning District Commission, 2004
Created by: Richmond Regional PDC, November 2005

V-24 - City of Richmond Critical Facilities and Areas of Concern

Roadways are often impacted when flooding occurs in the Richmond region. Floodwaters can inundate roads and bridges making them impassible. Table V-7 illustrates known problem spots. A more complete list of roads affected by regular street closures and, in particular, Tropical Storm Gaston can be found in Appendix E.

Table V-7 — Roadways Subject To Flooding By Jurisdiction	
Jurisdiction	**Roadway**
Charles City County	Route 5
	Route 155
	S.R. 106
	S.R. 600
	S.R. 609
	S.R. 614
Goochland County	Route 603
	Route 613
	Routes 610 & 648
	Route 645
	Route 667
	Route 687
	S.R. 6
	Cedar Plains Road
	Old Lower Tuckahoe Road
Hanover County (including Town of Ashland)	Bell Creeks Road
	Academy Drive
	Creighton Road
	Route 301
Henrico County	S.R. 6
	U.S. Route 1
	Creighton Road
New Kent County	Route 665
	S.R. 273
	S.R. 627
	S.R. 638
Powhatan County	U.S. Route 60
	U.S. Route 522
	Rocky Ford Road
City of Richmond	Intersection of West Canal and South Adams Streets
	Bainbridge Street at 20th Street
	Interstate-95 at the Broad Street underpass
	Belt Boulevard between Hull Street and Midlothian Turnpike
	Midlothian Turnpike – near German School Road and near Swansboro School
Source: Mitigation Advisory Committee; Richmond Regional Planning District Commission, Rural Flood Prone Roadway Study	

Estimating Losses

In the previous section the number and type of structures vulnerable to flood damages in each jurisdiction have been quantified. These structures are those that are located within an area designated to have a flood risk, and the potential damages to these structures should a

flood occur have not been quantified. Damages due to a flood event can include physical damages to structures, damages to structure contents, displacement time due to flood damages, loss of function of a public facility or infrastructure, and loss of business income. Typically estimates of these potential losses are prepared for a particular flood event, in most cases the 100-year recurrence interval flood. The primary factor utilized in completing these estimates is the anticipated flood depth during this event. The degree of damage to a structure during a flood event is primarily related to the depth of water over the first floor, with the higher the flood depth the greater degree of damage. Damage amounts also are affected by the type of structure impacted, the value of structure contents, and the type and value of the building or infrastructures function.

Unfortunately, due to the variation of the characteristics of the floodplain throughout the region, as well as the lack of detailed topographic data, the anticipated flood depth during the 100-year flood depth cannot be reasonably estimated. Flood depths vary considerably depending on the location within the floodplain such that no consistent average or typical value can be established. Data from the FEMA Flood Insurance Study does include the elevation of flood waters above the stream bed, but without topographic information for the areas within the floodplain, this data cannot be used to determine the depth of flooding for the structures within the floodplain. Therefore without an estimate of the potential depth of flooding, a comprehensive loss estimate for the region cannot be completed.

As stated previously, damage due to floodwaters is directly related to the depth of flooding over the first floor of the structure. Based on the FEMA Flood Insurance Administration (FIA) depth damage functions, damages from a 1-foot flood event can range from nine to fifteen percent of the building replacement value for the typical structure, and range from thirteen to twenty percent during a 2-foot flood event. Therefore, a $200,000 structure could experience between $18,000 and $30,000 in a 1-foot flood event, and between $26,000 and $40,000 in a 2-foot flood event. The specific estimated damage percentage is a determined by the number of stories and whether or not the structure has a basement.

Due to the lower quality of construction for mobile homes, damages to these structures are significantly higher than those of other structures and can vary from forty-four percent of the buildings replacement value in a 1-foot flood event to sixty-three percent damage in a 2-foot flood event. Unfortunately, in order to utilize these typical damage values to develop a regional loss estimate, more information regarding the potential flood depths would be required. Due to the lack of data available, collection of this specific data is beyond the scope of this study.

FEMA-Designated Repetitive Loss Properties

A repetitive loss property is a property that is insured under the National Flood Insurance Program (NFIP) that has filed two or more claims in excess of $1,000 each within a 10-year period. Nationwide, repetitive loss properties constitute 2% of all NFIP-insured properties, but are responsible for 40% of all NFIP claims. Policies cover both residential and non-residential properties.

Tables V-8 and 9 provide details on the number of NFIP policies, claims, and repetitive loss properties in the Richmond region. The "V-Zone" is the area along the coast that is subject to inundation by the 100-year flood event with additional hazards associated with storm-induced waves. The "A-Zone" is the area subject to inundation by the 100-year event.

Table V-8 – NFIP Policies and Claims

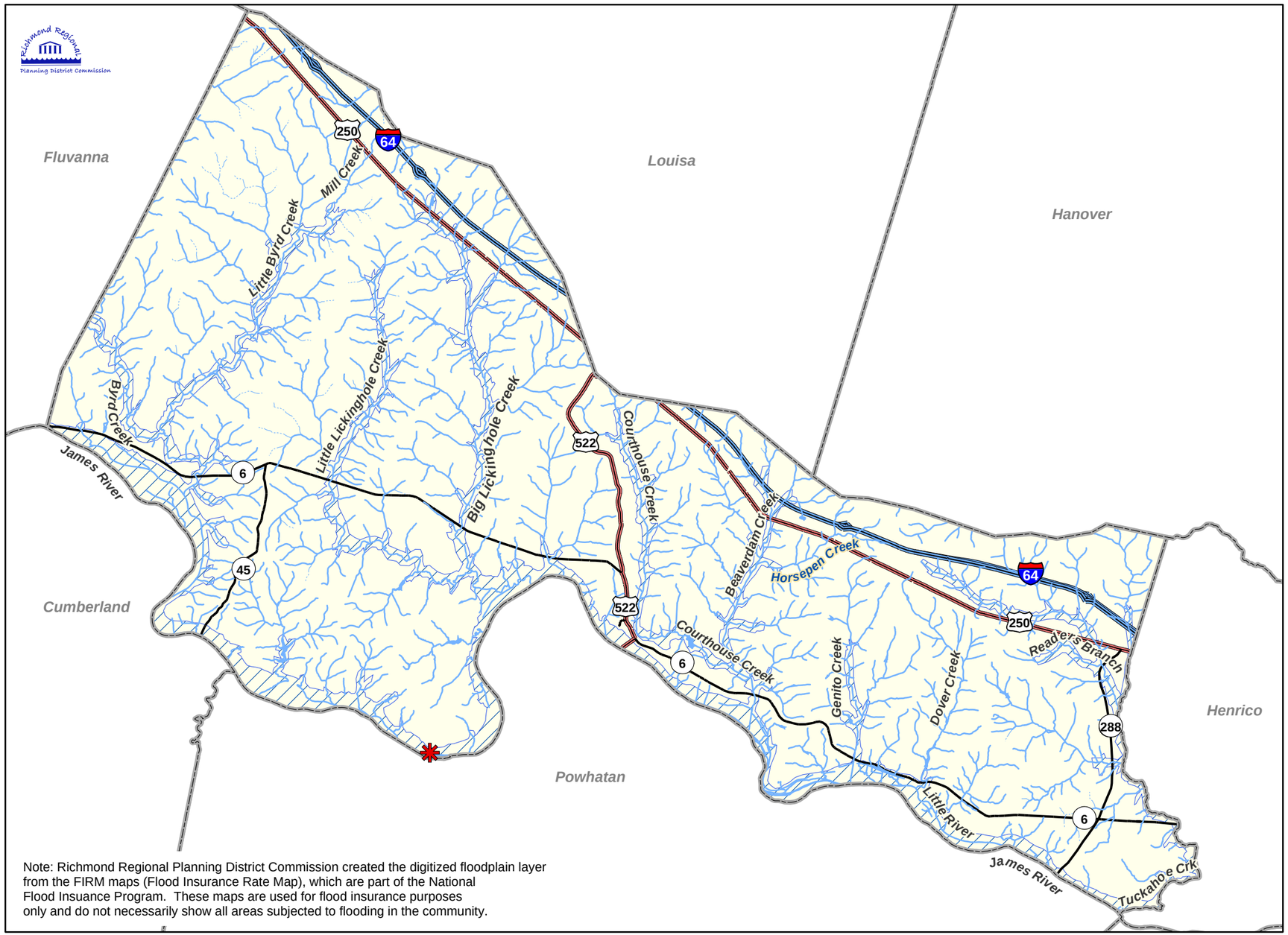
Community Name	Policies in V-Zone	Policies in A-Zone	Total Current Policies	Coverage Total ($)	Total Claims Since 1978	Total Claim Amounts Since 1978 ($)
Charles City County	0	4	11	218,2400	6	7,866
Goochland County	0	5	17	3,497,700	10	129,251
Hanover County	0	18	50	10,110,400	7	6,214
Town of Ashland	0	0	8	1,499,000	1	589
Henrico County	0	157	421	68,544,000	158	1,413,788
New Kent County	0	10	33	5,100,900	12	57,854
Powhatan County	0	1	10	2,086,300	0	0
City of Richmond	0	105	188	3,5186,300	455	8,591,650
Total	0	300	738	128,207,000	649	10,207,212

Source: FEMA. NFIP Insurance Report. January 7, 2004.

Table V-9 — Repetitive Loss Properties By Jurisdiction		
Jurisdiction	Number of Properties	Total Claims Paid ($)
Charles City County	0	-
Goochland County	1	94,690
Hanover County (including Town of Ashland)	0	-
Henrico County	15	1,238,282
New Kent County	1	72,025
Powhatan County	0	-
Richmond County	66	6,810,684
Total	83	8,215,681

Source: FEMA. NFIP Insurance Report. January 7, 2004.

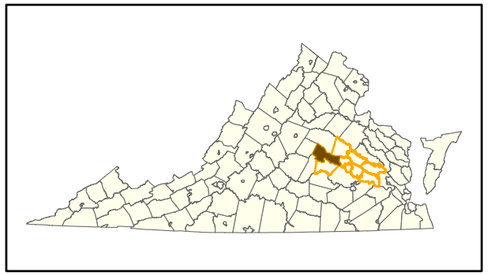
Repetitive loss properties account for about 11% of the flood insurance policies in effect in the Richmond region. Repetitive loss properties are responsible for about 74% of the claims made to the National Flood Insurance Program from the Richmond region. Figures V-25 through V-28 show the general locations of these repetitive loss properties. As seen on these maps, losses tend to be clustered.



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Structures Repetitively Damaged Due to More Than One Flooding Event

Goochland County



- Repetitive Loss Structure
- Interstate
- US Primary Highway
- State Primary Highway
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

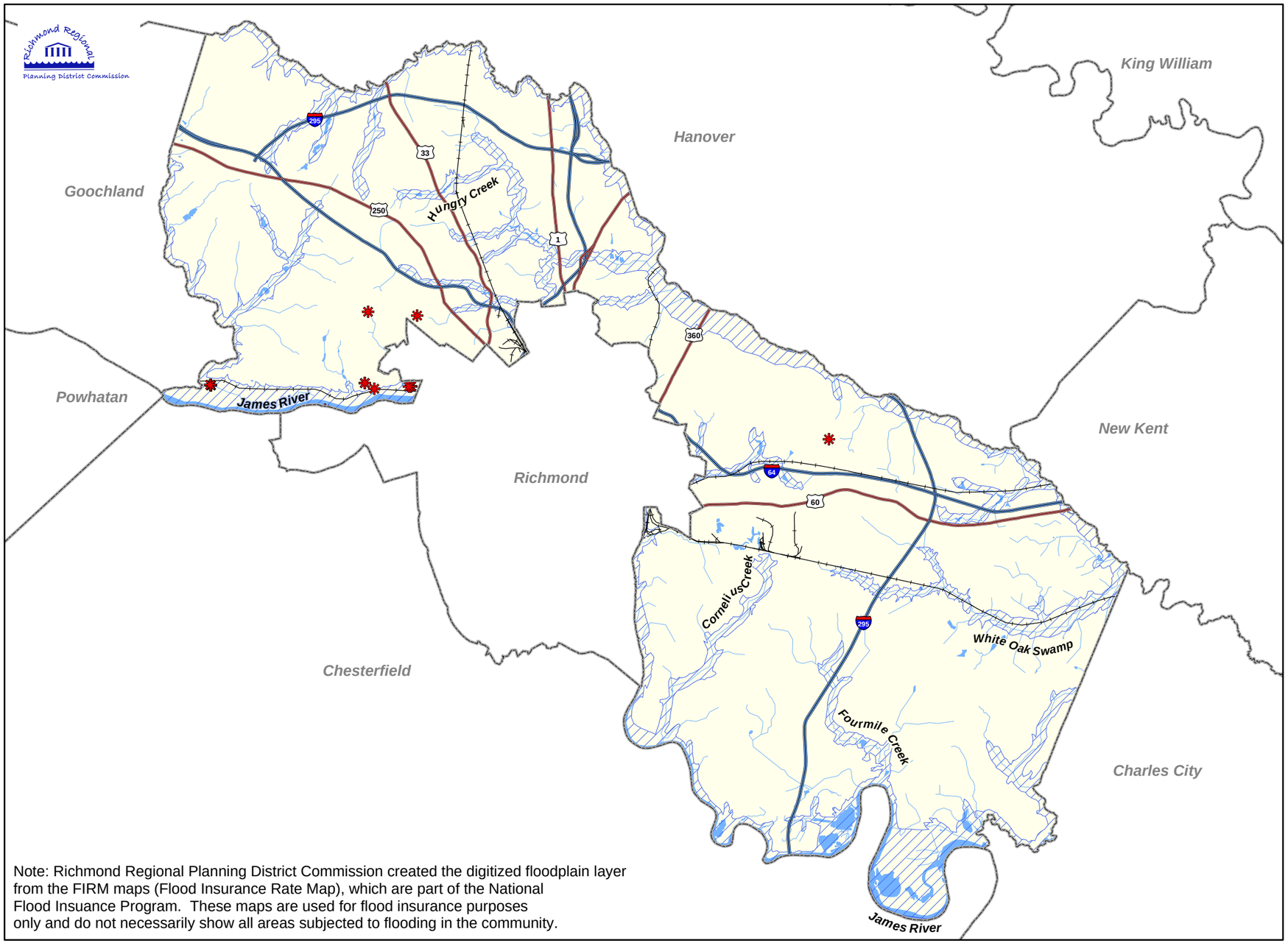
N

0 1 2 4 6 Miles

Source: US Census Bureau, 2000
Charles City County, 2004
National Flood Insurance Rate Map, September 5, 1993
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

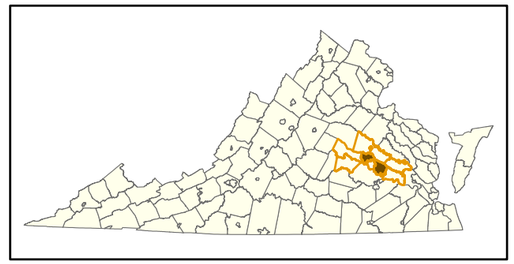
Figure V-25 - Goochland County Repetitive Loss Properties



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Structures Repetitively Damaged Due to More Than One Flooding Event

Henrico County



- Repetitive Loss Feature
- Interstate
- US Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

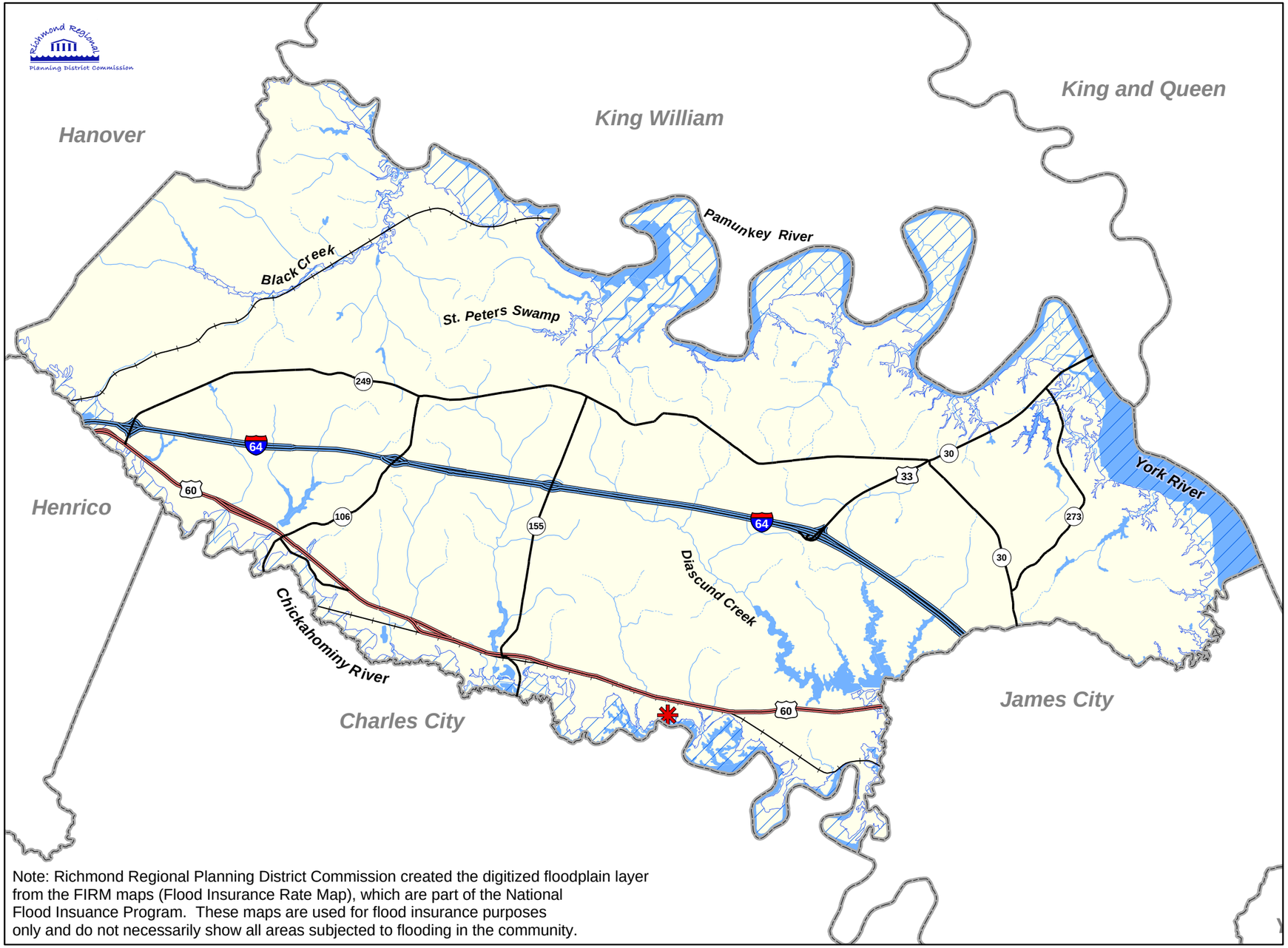
N

0 1.25 2.5 5 7.5 Miles

Source: US Census Bureau, 2000
Henrico County, 2004
National Flood Insurance Rate Map, September 15, 1981
Richmond Regional Planning District Commission, 2004

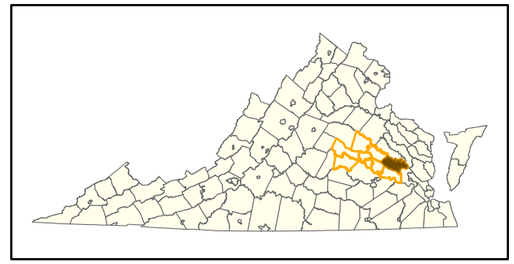
Created by: Richmond Regional PDC, November 2005

Figure V-26 - Henrico County Repetitive Loss Properties



Structures Repetitively Damaged Due To More Than One Flooding Event

New Kent County



- Repetitive Loss Property
- Rural Land
- Interstate
- US Primary Highway
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

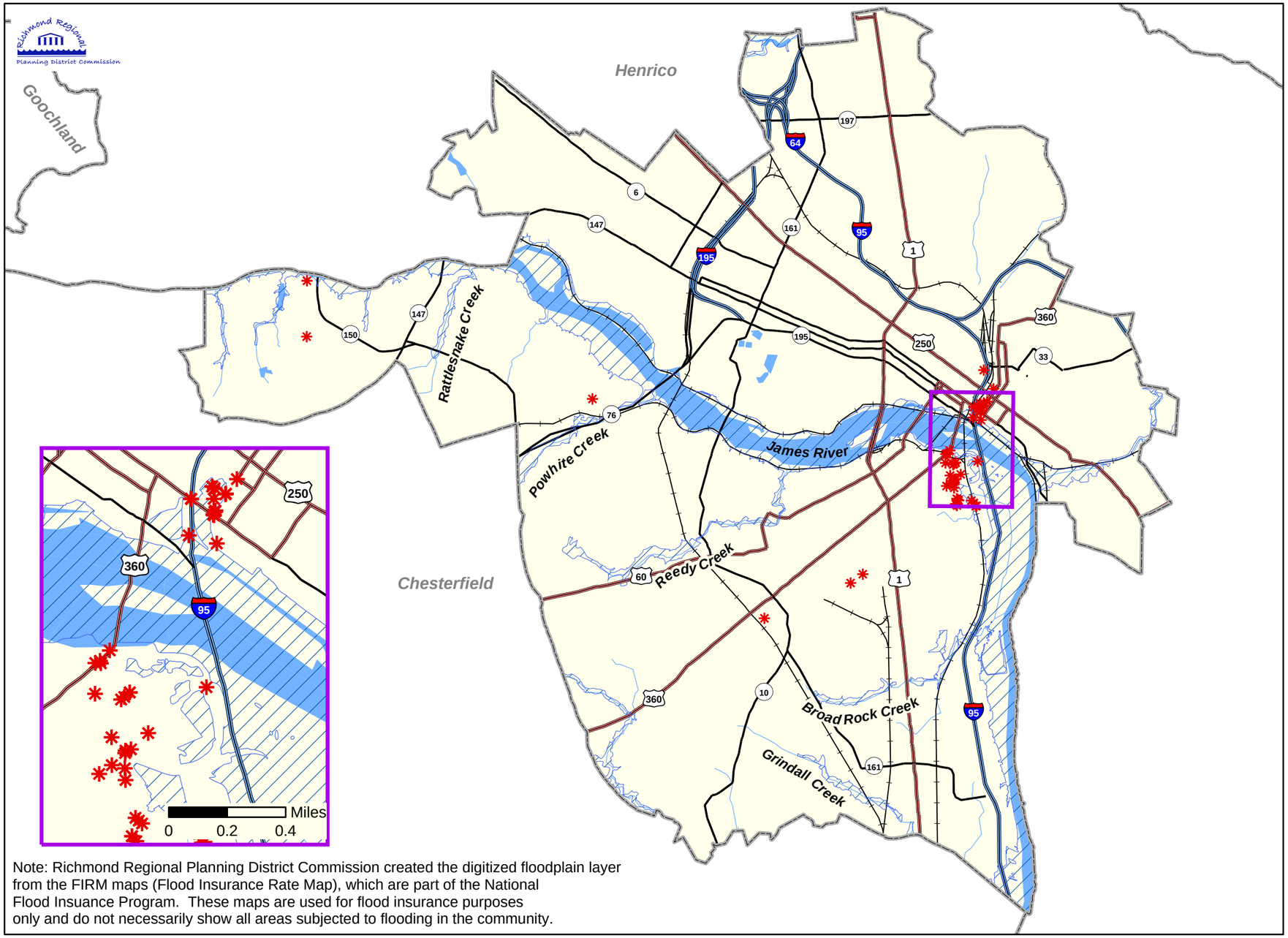
N

0 1.25 2.5 5 7.5 Miles

Source: US Census Bureau, 2000
New Kent County, 2004
National Flood Insurance Rate Map, March 1990
Richmond Regional Planning District Commission, 2004

Created by: Richmond Regional PDC, November 2005

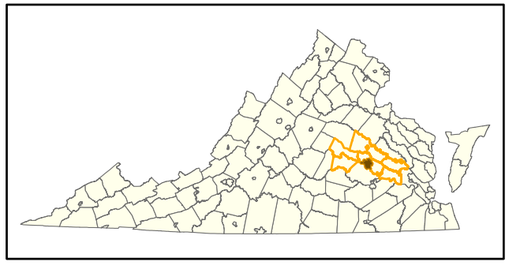
Figure V-27 - New Kent County Repetitive Loss Properties



Note: Richmond Regional Planning District Commission created the digitized floodplain layer from the FIRM maps (Flood Insurance Rate Map), which are part of the National Flood Insuance Program. These maps are used for flood insurance purposes only and do not necessarily show all areas subjected to flooding in the community.

Structures Repetitively Damaged Due to More Than One Flooding Event

Richmond City



- Repetitive Loss Property
- Interstate
- US Primary Highway
- State Primary Highway
- Railroad
- Stream
- Intermittent Stream
- Waterbody
- Floodplain (100-year)

N

Miles
0 0.5 1 2 3

Source: US Census Bureau, 2000
Richmond City, 2004
National Flood Insurance Rate Map, September 15, 1979
Richmond Regional Planning District Commission, 2004
Created by: Richmond Regional PDC, November 2005

Figure V-28 - City of Richmond Repetitive Loss Properties